A TELEPHONE FOR THE WORLD

IRIDIUM, MOTOROLA, AND THE MAKING OF A GLOBAL AGE

MARTIN COLLINS

VISIT…

A Telephone for the World

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Iridium, Motorola, and the Making of a Global Age

Martin Collins

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Preface

How does one tell a story of recent globalization? Where to place the focus? What scale of argument—personal, local, national, or planetary—seems right? A core argument of this book is that the 1980s and 1990s were a critical formative period in the globalization we know today. My aim is to show that, through a case study of Motorola's Iridium satellite venture, we can see the outlines and some of the details of how this period of globalization was composed and enacted. And given this choice of case study, the lens through which we look is that of the corporation, the then Fortune 500 multinational Motorola and its start-up, Iridium. The hope is that this narrative provides critical insight into globalization as a phenomenon and does so in a way that stimulates the work of other scholars.

When I started this project (too many years ago), my first thought was to do a different history, to use Iridium as a private-market, big space technology effort, conceived at the end of the Cold War, and compare it with state-sponsored big technology in the years after World War II. How did state and market auspices and political economy differ in these two contexts? But as I explored the possibilities—spurred on by my collecting an Iridium satellite for the Smithsonian National Air and Space Museum—I realized the Cold War / post–Cold War distinction, though important, was embedded in a larger problematic of 1980s and 1990s globalization and of the place of the United States therein. The engineers, managers, politicians, advertisers, military personnel, government bureaucrats, in the United States and elsewhere, at the heart of this story took the "global" as a central category in their own work and thought. It was an experience they saw themselves living in and creating at the same time—it was a fast ride to a place not yet realized. This recognition led to this attempt to understand what was being composed, with what meaning and with what consequence.

Recent history, of course, is a tricky affair. It can be harder to grasp how the story comes together, whether themes and their historical weight have been astutely identified, related, and assessed. Or whether fresh empirical evidence might lead one to reframe one's organizing questions. But it also can be provoc-

ative on a personal, scholarly level. This book relies heavily on oral history interviews with Motorola and Iridium personnel and a few others. To a person, people gave generously of their time (some for hours and hours) and invited me into their offices and homes (even a seagoing boat) and gave me my first taste of rattlesnake, somewhere near Phoenix. But what I valued and benefited from most was their generosity in entering into the spirit of my enterprise. The book would not have been possible without their collegiality and sense of "yea, let's do this, it's a great story." It was a wonderful privilege to get to know them and see the world through their eyes. With the note on sources in the bibliography there is a list of those interviewed. I can't say "thanks" enough.

I expect in many ways this narrative may seem off the mark to them. They worked at Motorola or Iridium every day, experiencing up close the nuance and texture of the project and the larger world. For many, Iridium was a visionary undertaking, fueled by individual passion and commitment. Perhaps, too, they will have a different view of what was important or how I have tried to limn the bigger meanings of their effort. I hope my broader structural approach to a story that is fundamentally theirs does not seem too out of kilter with their own sense of this history.

I owe thanks to my institutional home at the National Air and Space Museum. The Smithsonian provided two grants in support of this research. I thank my colleagues in the Department of Space History, a quirky, delightful crew, looking always to sustain and enliven our collegial, scholarly life together. That's been an indispensable boon through the years. A shout out to JoAnn Morgan, the department's administrative assistant, who will be retired by the time this book is published: bless you for everything. My greatest intellectual debts during this project are to Philip Scranton, Paul Forman, and John Krige. They have been great intellectual companions, always deepening my sense of scholarship and history as a critical mode of knowing the world. Through the years, a number of museum interns and volunteers helped with the project; I thank them profusely. Not least, through the final stages of book preparation, I benefited from the collegiality of Iridium Communications, Inc. (successor company to the original Iridium) and its CEO, Matt Desch.

To my sons (your very own paragraph!), all my love.

A Telephone for the World

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Introduction

This book explores the story of globalization in the 1980s and 1990s as seen through a venture called Iridium, a privately financed and operated network of satellites that provided telephony service over the entire planet—a communications first. In its ambition, scope, challenges, and organizing ideas, Iridium provides telling insight into a crucial period in US and international history. By the beginning of the 1990s, neoliberal ideology and policy had been ascendant since the 1970s and through the 1980s had become broadly transnational in its reach. With the end of the Cold War and the collapse of the Soviet Bloc, it gained additional geopolitical purchase. In this new landscape, the United States stood, in the rhetoric of the Cold War period, as the lone superpower, possessing a dominance that was expressed not only through the state but also through an increased emphasis on the role of markets and of US corporations on the global stage. Such merging of public and private interests itself was expressive of the turn to markets and neoliberal ideology.

Initiated in 1987 by Motorola, a Fortune 500 US multinational, Iridium was intimately bound to this transformation. Its study uncovers some of the ways in which corporations (the much talked about but understudied historical actors of this period) constituted and were constituted by the global.[1] Iridium encapsulated such change in a key organizational and symbolic way: its business concept, a mirror of its planet-encircling satellite constellation, was from its founding moment literally global. Its strategic goals, structure, marketing and branding,

and the mechanics of its operation were predicated on the planetary global as an organizing construct. This stood in contrast to the typical trajectory of the twentieth-century multinational corporation, originating in one nation and then expanding its reach across space and time. Such distinction highlights the ways in which the global was becoming a material reality and an all-encompassing imaginary for conceptualizing new modes of action and meaning.

The interplay between the day-to-day activities of Iridium and the emerging contours of the global is at the heart of this account. The global was not an abstraction but the product of a variety of overlapping, discrete political and technical projects—some derived from the market, some from state action, including by the US military. The global's necessary flip side, the "local" (or, more accurately, many locals), entered fundamentally into Iridium's history and this broader process of change. At each step, the venture was steeped in this meeting of border-spanning and border-maintaining forces, and, in turn, was steeped in the idea of the global, which helped define them.

The Iridium story highlights the ways in which the global, especially in the West, became descriptive of the condition of life in the 1980s and 1990s. Enhanced communications modalities, highlighted by the emergent Web and the widened use of communications satellites, and the media's constant attention to such changes made the global a circulating, transnational trope, a widely used category intended to encapsulate the changes under way. Satellites (in particular, communications satellites) gave the global a powerful, new connotation, not just as a metaphor for transnational flows of money, processes of production, and culture, but as an indicator of an emergent capability to project market values, power, and control over the totality of the planet—through commercial and military means.[2] The space-based perspective thus was central to the incarnation of the global that took shape through the past several decades. It provided instrumentalities that were by design global and by their very presence and use made the global a compelling category. Through projects such as Iridium, the global as a way of life, as a referent for thinking and acting for nation-states, for corporations, and for First, Second, and Third World peoples, was thrown into higher relief.[3] By the end of the Cold War, the conjunction of such a notion of the global and the 1980s turn to markets inspired not only the creation of Iridium but also the launch of several other corporate satellite constellation initiatives, mostly US-based, of similar ambition: Globalstar, Odyssey, and ICO. By the mid-1990s, an even grander effort called Teledesic, backed by Microsoft's Bill Gates, took shape, intending to provide global Internet service but never proceeding beyond the planning stage. Yet

among these efforts, Iridium stood out as the vanguard of such reorientation, its compositional elements touching each nerve of the period.

The idea and practices of the global in the years just before and after the end of the Cold War world are at the center of this book. Its meaning, its possibilities, its execution through a series of discrete, diverse actions preoccupied the historical actors in the Iridium story. Satellite factory workers, managers, corporate executives, investors in the United States and in other countries, regulators, politicians, the media, and others saw themselves as participants in and contributors to a new sense of the global. This sense was tentative, was in process, and often embraced disparate and sometimes conflicting elements, with different actors seeing the global in different ways. Motorola and Iridium inherited Cold War–era notions of the global and refashioned them as they developed the project—notions that defined the venture within these corporations as well as in its multiple connections around the world.

In Iridium, three overlapping connotations of the global emerged. The first was practical, expressed through a series of discrete efforts in which new and existing national and international institutions, policies, political networks, and technical processes were cast or recast to create the mechanisms that would facilitate the operation of a pan-national, global business. Second, the venture's Earth-girdling communications system exemplified the 1990s shift in meaning of the global from a loose metaphor to a reality in which the entirety of the planet became an *actual* field for projecting power and control through fully global infrastructures. The global thus was not only and importantly descriptive of the intensified dispersal of manufacturing from national to transnational contexts or of an evocative shorthand for claims of the "death" of distance and time, but also of a qualitative shift in capability.[4] The third was ideological, integrating the project, as an exemplar of private-market action, into the concepts and rhetoric of a universal liberal democratic philosophy—in short, to reinforce the neoliberal claim that liberality in markets provided the foundation for individual liberty.

These three elements defined Iridium's development and highlighted the creative tension among rhetoric, ideology, and the basics of engineering and business development. At first blush, the engineering and business effort focused on practical challenges, inside the project and in its dealings with world—the basics for making the venture successful and profitable. Rhetoric and ideology, though, were deeply entangled in this work, investing the project with particular (and not always consistent) meanings. How might project leaders bring all this

into a common framework that linked the project's many US and non-US sites of activity and the global? One fundamental response was to invoke "culture" as a robust, all-purpose, multivalent concept, one that could have a practical cast, leading, say, to improved work on the factory floor, or could serve as a generalizing solvent that made it possible to smooth potentially fraught interactions with nations, local communities, and other corporations across the transnational landscape. This strategy drew on a specific history. Beginning in the 1960s, "culture" expanded within the academy as an area of research and theoretical departure in the social sciences and then spread to other professionals interested in organization and management.[5] In the hands of Motorola and Iridium, culture as a conceptual and practical instrument sought to respect the local (whether inhering in an individual, an institution, or a geographic region) but assumed it could be harmonized with the global (as conceived by the venture). Such a perspective was codified through training, publications, and even formal institutional creations such as Motorola University (established in 1989) and its Center for Culture and Technology.

In Iridium, by focusing on specific historical actors, the 1990s global is seen as a condition that was actively fashioned. Technology; corporate action; interests of the US state; culture; ideologies of the market; images of innovation, freedom, transcendence, and romanticism; and the countervailing and sometimes reinforcing interests of many "locals" fed into it. And, in turn, this condition, shifting and not quite controllable, shaped Iridium—its sense of identity, its outlook, its place in a larger drama. As a practical exigency, the narrative is aimed at understanding the outlooks and actions of Motorola and Iridium—of Motorola as a multinational corporation, of the Iridium engineering enterprise within it, and of Iridium as separate business enterprise. The many "locals" the narrative might embrace will be given much less emphasis, a reflection of the challenges of acquiring relevant source materials. The account will be US-centric.

In the following, then, we pursue the Iridium story through the transition from the Cold War to the market-oriented landscape of the post–Cold War years, tracing the varied, layered manifestations and meanings of an engineering and business venture intersecting with the idea and practices of the global. The global as a problem and a question in this period is intimately bound up with understanding the corporation—especially the US multinational corporation, in its role as mediator and shaper of markets and of the changing character of nation-states in a world in which neoliberal ideology was ascendant. As a case study this can be only a partial engagement with a complicated historical ter-

rain that embraces not only the 1980s and 1990s but also the twentieth-century trajectories of colonialism and postcolonialism—the inevitable backdrop to a US- (and European-) dominated articulation of the global. But nonetheless it brings forward core period questions: How was the global constituted? How did corporations conceptualize and carry out their own involvement in this process? How did technology—satellite communications, in particular—become an emblem of globalization's processes and seemingly beneficial inevitability? How did the specifics of business organization, governmental policy, and technological practice correlate with globalization and neoliberal market ideology? How, in turn, did period market ideology map onto persisting historic inequalities between First and Third Worlds, North and South, West and East in the post–Cold War context of US geopolitical dominance? The Motorola and Iridium stories open these historical questions to provide a better grasp of this recent period of momentous change.

Chapter One

Iridium and the Global Age

> The map of the world shows no country called Technopolis, yet in many ways we are already its citizens. If one observes how thoroughly our lives are shaped by interconnected systems of modern technology, how strongly we feel their influence, respect their authority and participate in their workings, one begins to understand that, like it or not, we have become members of a new order in history.
>
> LANGDON WINNER, *THE WHALE AND THE REACTOR*, 1986

> This is not just a phone; it is a vision.
>
> ROBERT KINZIE, CHAIRMAN, IRIDIUM, INC., 1992

In June 1990, Motorola publicly announced an ambitious business venture called Iridium—an undertaking intended to provide cellular voice (and some data) communications to any point on the Earth's surface.[1] Soon thereafter Motorola established Iridium as a separate corporation, a "start-up" in the parlance of the time, aiming to attract investors to share in the enterprise. Within a few years, more than a dozen investors had joined in, representing a diverse sampling of companies and countries around the world. These included, notably, state-derived investments from former Cold War adversary Russia, the People's Republic of China, and India, as well as seed money from companies in Taiwan, Japan, South Korea, Thailand, Germany, Italy, Saudi Arabia, Venezuela, and Brazil—each of which then placed a director on the new company's board of directors. The venture's global scope and representation led *WIRED* magazine to dub the undertaking as the "united nations of Iridium," a new market-driven reinvention of the state-centered United Nations.[2]

The project's signature technical feature was a constellation of 77 satellites in low Earth orbit—the "77" the same as the atomic number of the element iridium, and hence the source of the venture's name.[3] The orbiting satellites served as the equivalent of cellular towers, connecting to mobile customers below, using wireless handheld phones. As one of the founding engineers noted, the constellation "bathed the planet in radiation," enabling a completely global phone system—a

seeming teleological endpoint to more than a century of patchwork, geographically limited terrestrial communications and to the not fully global system of satellite communications initiated in the 1960s.

The project and its unveiling (after three years of in-house study and development) embodied the historical moment—a microcosm of the tangled interconnections among big business, big technology, and the changes that roiled politics, international trade, and foreign policy during the 1980s and 1990s, with the tearing down of the Berlin Wall in 1989 a symbolic watershed. The Iridium announcement was splashily global. Four press events were held simultaneously—in London, Melbourne, Beijing, and New York City, a nod to the project's geographic scope and the realities of generating interest in key financial, media, and political circles. The New York City event was the focal point. The renowned Hayden Planetarium played host, adding a historical echo to the new venture. In 1951, the Hayden had hosted the Symposium on Space Travel, a first-of-its-kind event that helped stimulate public interest in space exploration well before the launch of *Sputnik* in 1957.

Iridium seemed a marker of a new phase in the decades-long effort to gain mastery over the space environment. The private sector, through a leading American corporation, one that notably had no tradition of spacecraft or communications satellite manufacture, was confidently willing to initiate the most expensive business start-up in history to create a unique infrastructure in space. The market was now positioned to join, and perhaps, in select areas, supplant, government in the exploitation of space and, by implication, to bring individuals, as entrepreneurs and consumers, closer to the space experience. More broadly, the venture offered an exclamation point, a hosanna, to the possibilities of the market, of an age in which entrepreneurship and technology might subsume the globe, make the control of time and distance a consumer option. These messages quickly gained amplification: within months of the Iridium announcement, several other firms revealed their plans to provide global telephone and data services.[4]

The press response to Iridium was enthusiastic. More than 1,400 newspapers carried the announcement—many on the front page. *The New York Times* ran on the front page "Science Fiction Nears Reality: Pocket Phone for Global Calls." In good pop culture fashion, the announcement, too, found its way into a Johnny Carson monolog and a Batman comic strip. The Beijing event received substantial play in China, running on the evening news. Approximately 250 million Chinese viewers heard parts of the Motorola press release and saw dubbed portions of a promotional video depicting how the satellite communications system would work.[5]

These press events and media coverage implicitly and explicitly drew attention to themes that would make Iridium symbolic of one of the defining threads of the 1990s—the idea that technology (particularly the technologies of communication), business, consumer culture, and globalization were fusing into a ubiquitous, potent force for change and transformation, extending from the individual to the transnational, remapping the world with liberal democratic ideals.[6] The burgeoning spread of the Web, just beginning, with its celebration of individual self-fashioning and a-hierarchical connectivity, served as the cynosure of such change. Though technology occupied a central place in this narrative, it was fundamentally entwined with the period's belief in markets and in individuals as consumers and creators as the necessary and moral means for social life—the creed of neoliberalism, which had been in ascendance since the 1970s, but became the dominant framework for economic and political thought in the United States and the West in the 1980s and after.[7]

The US media facilitated the regard for such views and the transformations they implied. The Iridium announcement played to the presumption that as the Cold War and its geopolitical dividing lines waned, technology, business, and markets already had become the preeminent engines of change, the definers of what might come next. Beginning in the 1980s and through the 1990s, US media—from cable television, to newspapers, to new magazines such as *WIRED*, with their reach, in the 1990s, amplified by the Web—presented technological advance, business entrepreneurship, and deregulated markets as the core of the emerging post–Cold War world.[8] Broad popular tropes such as globalization captured this mix of changes, but so did specific political coinages such as the Washington Consensus and the New Economy. The former advanced deregulation and markets as the means of social and economic advance for developing countries, the latter a claim that information technologies were recasting fundamentally existing economic structures.[9]

In the *New York Times* Iridium article, after detailing the ambitions of the project's technical vision, the writer turned to the challenges of gaining financial backing and regulatory approvals around the world. Though noting that such hurdles might derail the proposed project, all such impediments seemed secondary. The primary thing, but subdued and in the background, was that this global project, with its technical and political complexities, was, in the context of the 1990s, a natural, forward-looking example of market initiative.

Motorola—through its history and standing as a successful high-technology company—seemed a poster child for this emerging worldview. A Fortune 500

company, Motorola was the third-largest electronics firm in the United States and the largest manufacturer of cellular equipment in the world. It had sales offices around the globe and production facilities in more than 45 countries, including China.

In the 1980s, Chairman Robert Galvin, son of the Motorola founder Paul Galvin, began establishing cellular equipment production and distribution facilities in that country, building ties to political leadership. By the time of the Iridium announcement, China had a working familiarity with Galvin and Motorola, making it possible to use Beijing as a geopolitical backdrop and the Chinese media to stimulate interest in the new project. Soon thereafter, China, through one of its quasi-governmental entities, the China Great Wall Corporation, became an investor and, later, in the 1990s, played a crucial role in the project by providing through contract Long March launch vehicles to place Iridium satellites into orbit. The Iridium relationship with China was an example of the exquisite oppositions and tensions of the post–Cold War world: a prototypical standard-bearer of the capitalist order and a communist regime finding common cause in separate, but overlapping conceptions of the centrality of markets in period life. On one side of the balance, there was the novelty, the seeming incongruity, of a communist government committing investment capital to an American corporation. On the other, there were the intertwined, seemingly inexorable logics of the market and of technology as pathways to the future, reorienting and dissolving existing political distinctions—a process that, in some measure, the West and China both viewed as natural and the order of the day.[10]

Technology, corporations, and markets stood out as compositional elements of the global milieu of which Iridium was a part. But central to and deeply embedded in this triumvirate was the techno-cultural phenomenon of communications. At the time of Iridium's beginning, the personal computer, the Internet, the World Wide Web, cellular telephones, undersea fiber-optic cables, satellite communications (especially as it related to direct-to-home television and immediate "you are there" long-distance news coverage) were all nascent as technologies or as ubiquitous services or commodities.[11] But separately and as a collective development, they had become imbued, through the 1980s and into the 1990s, with rich cultural symbolism—a symbolism that fused technological advances with the possibility of reinvigorated individual liberty and expression.

A common vernacular quickly gained hold, heralding historic transformation: "information revolution," "information society," and other coinages proclaimed a line separating the past from the present. In this framing, the new information

technologies seemed to vest the individual with a dual potency: enhanced autonomy as a social and political actor and enhanced ability for self-expression. The new technologies thus were an amplified ratification of Enlightenment values, of liberal democratic ideals that were the foundation of the American experience. They embodied the sanctity of the individual as the measure of all things, of liberty in all its guises—from politics to the pursuit of happiness. In the United States, particularly, and in Europe the association of communications in its new forms and liberal democratic values had special hold and found constant expression in the media and from government, business, and, to a lesser degree, academic figures.[12] Long-established intellectual figures such as Jürgen Habermas, with his idealized notion of a citizen-oriented public sphere, acquired renewed relevance.[13] This was consistent with, if not always in alignment with, the values attached to capitalistic markets and the idea of the consumer as a liberal democratic citizen. The result was a potent conflation of communications technologies and their seemingly endless promise of individual autonomy, freedom, and fulfillment through markets—a template seemingly applicable to anyone, anywhere, regardless of their cultural attachments.

As Motorola initiated Iridium, this brew was one of the primary exports issuing from the West in the wake of the Soviet collapse. As the sketch of Iridium in China suggests, though, this tangle of ideology, markets, and technology could be untangled, its meaning reoriented.[14] Though US officials might hope that the liberal democratic associations of markets and communications technologies might travel west to east intact and transform Chinese society, the Chinese saw a different configuration of associations. The Chinese view, as it had been for the Soviet Union, was that technology served the interests of state and society, that technological progress was integral to the development of the collective. Though in the West the fall of the Berlin Wall stood as a preeminent symbol of the opening of geopolitical space to neoliberal values and practices, it was juxtaposed historically with another symbol: Chinese repression of political dissent in 1989 in Tiananmen Square. Western corporations and competitive markets were to be engaged and used gingerly as tools; the goal was to extract the technical from the matrix of markets and Western ideology.[15] The ascendance of the individual celebrated in the West largely disappeared in the official Chinese perspective. In the 1980s, this dance between West and East had become more insistent—the West eyeing the promise of a vast (but never quite realized) market, the Chinese eyeing the fecundity and sophistication of the Western technological cornucopia. Iridium provided an opportunity to improvise on this dynamic and highlight the

multiple meanings embedded in the project.[16] Such culture and value contrasts also occurred (but with less ideological dissonance) in other countries and regions that became charter members of the "united nations" of Iridium.

Situating the Iridium Story in Historiography

The foregoing suggests the venture's origins and the multiple period threads that give the story meaning. The aim here is to explore this complex, to see if the particulars of the Iridium case might be related to broader, still incomplete characterizations of the 1980s and 1990s—narratives of big technology at the end and in the early "post" years of the Cold War and of interpretive frames such as "globalization," "postmodernism," and "neoliberalism." It is to view the Iridium undertaking as a useful and potentially telling snapshot, an examination of how one set of actors began to engage the opportunities, challenges, and zeitgeist of an era in which technology, markets, corporations, states, and culture combined in ways that replicated and departed from immediate antecedents, especially in regards to the Cold War nation-state and Cold War capitalism.

In a descriptive sense, drawing on Thomas Hughes's research, Iridium seems a typical big technological system, an interdependent aggregation of technologies, institutions, politics, and role-playing actors—inventors, investors, managers, and others—animated by overlapping worldviews.[17] Too, in outline, it poses the history of technology's fundamental question: how are technology and culture drawn together and made (or at least expressed) through such projects? As a case study, it offers the opportunity to explore the ways in which Motorola and Iridium constituted notions of the technological and cultural in and through the project and to situate the venture in the geopolitical transition from the Cold War to after.

As an exploration in periodization these points raise issues of comparison. As a story centered on corporate action and technology, Iridium invokes as background a range of literature pertaining to the rise of vertically integrated firms in the nineteenth century, the establishment of corporate laboratories, the articulation of state-market relations in the first half of the twentieth century, and the relations between the state and industry in the Cold War.[18] Each of these periods pointed to shifting configurations of technical knowledge, institutions, social life, and politics.

The 1986 Langdon Winner quote, at the beginning of this chapter, is a historical marker of the range of issues just described. This characterization is deepened by the very next lines of his text: "To an ever-increasing extent, this

order of things transcends national boundaries to create roles and relationships grounded in vast, complex instrumentalities of industrial production, electronic communications, transportation, agribusiness, medicine, and warfare. Observing the structures and processes of these vast systems, one begins to comprehend a distinctively modern form of power, the foundations of technopolitan culture." His analysis points to technology's penetrating ubiquity, not just on national but also on transnational scales, implicated in a transformed cultural condition and of individuals' experience therein—"a new order of history," exhibiting a distinctive "modern form of power" and culture. Winner's assessment identifies, in the style of Hughes, the importance of systems ("vast, complex instrumentalities") to the historical moment. He, though, differs strikingly from kindred thinkers, such as Lewis Mumford and Herbert Marcuse, who wrote immediately prior to him. They saw emerging a similar transformation and condition, grounded in the practices and animating assumptions of big bureaucracies, Cold War nation-states, and capitalist institutions. But the thrust of their analyses was to critique the consequences of such change: the diminished stature of the individual as defined by Enlightenment ideals, the shifting relation between the human and the natural worlds, and a cultural orientation that favored ends over means (the idea of instrumental rationality). Their critiques were sociological and philosophical, aimed at countering the perceived political trends of the postwar period and the imbalance of power between individuals and the dominant institutions such trends embodied.

Winner's quote, in contrast, seems to see instrumentalities and the condition in which they are implicated as a given, an entrenched framework of existence. It is unclear how politics and power operates and who may wield it, with what efficacy; Winner labels individuals as "citizens" but with an unspecified relationship to place or political authority, however vested or expressed, however clustered in national or transnational entities, however bound to prior disparities between developed and developing regions of the world. The question of the texture and distribution of power, absent from Winner's presentation, is what fueled a renascent interest in the use of terms such as "empire," "imperialism," and "hegemony" to characterize US standing and influence in the late twentieth century.[19]

Winner's view is of note here because it comes after the spate of critique of the 1960s and early 1970s, but before the greatest effusion of commentary on globalization and neoliberalism that issued in the late 1980s and 1990s. That literature, to be further discussed, has oscillated between reifying globalization as a condition (similar to Winner) and as a contingent historical process open

to critique. This tension is embedded in the importance of 1989 (to 1991, with the full collapse of the Soviet Union) as a marker of a broad geopolitical expansion of capitalism, substantially US-centric, neoliberal in outlook, succeeding as the dominant economic and political paradigm. Thus, one might readily see, at least in part, Iridium as expressive of Winner's characterization of large-scale technological systems, conceptualized and implemented, as unexceptional. But in its specifics, in the activities of its historical actors, Iridium highlights the question of how to relate the history of the several decades before the end of the Cold War to the subsequent, broad-based (among elites) enthusiasm for markets and corporations, of how transnational pathways and structures were constituted and how power operated, at what scales. The Iridium story, though chronologically a window onto the post–Cold War 1990s, is thus equally a reflection on the 1980s—that time in which globalization and neoliberalism come to shape the national and international landscape and, importantly and more specifically for this narrative, cause Motorola to adapt and reorient itself to this new world, of which the conceptualization of Iridium was one part.

Winner's claim is noteworthy from another angle: it is a demarcation unconnected to an overriding domestic crisis or large-scale geopolitical tension, such as, in the United States, the state-market concern that shaped the Progressive and New Deal eras, or the Cold War question of the interpenetration of state interests with the civil sphere, especially industry and academia. Rather, this state of affairs, it seems, is the accretion of less dramatic, discrete actions and policies, a convergence of markets, technology, knowledge, and state interests into a loose whole that became qualitatively different from its parts. Such characterization maps onto the end of the Cold War, which unlike the aftermath of World War II did not inaugurate a broadly reconfigured geopolitical order, but provided expanded possibility for a political economy and ideology already well evident in the mid-1980s.

Winner's systems, too, encompass another critical transformation: the creation of "technopolitan" humanity—a new condition, he implies, that unites and defines all of us across circumstances of class, race, ethnicity, gender, and geographic condition, a seeming "family of man" composed of involuntary citizens in a de facto polity, vulnerable to the increasing reach of technology. Put another way, the claim runs deeper: that the values and effects of the technopolitan condition are inscribed, in some fashion, in individuals, shaping intimately their sense of the world. It is thus the strong claim of culture that the "global" us live in and through a particular system of values, signs, and material conditions, a

transnational culture that rivals and is in confrontation with many local cultures. The tension evident in Winner's quote, and in the broader literature, is whether this condition is epiphenomenal, explained through the workings of capitalism as a market and state-organized force, and thus continuous with prior history, or whether it is distinct, a new causal framework.[20]

Winner is one among many, and from several disciplines, who began in the 1970s and early 1980s to announce the emergence of reordered local and global cultural conditions, deriving from or coincident with the Cold War: John Kenneth Galbraith's *The New Industrial State*, Daniel Bell's *The Coming of Post-Industrial Society*, a literature announcing the era of the Information Society, and a building crescendo of books on postmodernism in which the relations among technology, corporations, and culture were central.[21] Winner's reflections stand poised, chronologically and conceptually, between two not-quite kissing cousins: the literatures of the postmodern and that of globalization and the neoliberal. The former found expression in foundational works by Jean-François Lyotard and Fredric Jameson in the years prior to Winner's "Technopolis." The spate of writings on globalization and the neoliberal burgeoned shortly thereafter, stimulated by political and literary events of 1989: the symbolic end of the Cold War in the dismantling of the Berlin Wall and in the publication of Francis Fukuyama's now iconic "End of History?" essay.[22]

To juxtapose Winner with this constellation of other intellectual currents is to risk eliding important differences, but each shares common elements that touch on and raise questions for the Iridium story—the claim of a freshly emerged universal cultural condition featuring specific instrumentalities (technologies, particularly those relating to communications, markets, corporations, and state and international policies) and of a global zeitgeist bound up with these means. Yet the conceptual positions of the postmodern and the global can be diametrically opposed. Lyotard's well-known assertion that grand narratives, especially those rooted in the Enlightenment, no longer had an intellectual foundation, stands in contrast to the hyper-robust invocation of those very same ideals by globalization's proponents when situated in the primary organizing conceit of markets.[23]

The commonalities point to specific ways in which these literatures may help frame description and explanation in the Iridium story and, in turn, how this account may offer an empirical reference point for broader issues of interpretation. Both postmodern and globalization literatures foreground the role of the corporation—as creator, consumer, and applier of technology, as advocate and

builder of a favorable global political and market order—and thus raise the issue of the concrete ways in which corporations implement projects and shape the transnational landscape.[24] This poses the further question of whether one sees the corporation as a master architect or as a circumscribed agent, bound to the larger tides of markets or culture. Through this lens, in the Iridium case, one can ask, through their constructions of the global, what Motorola and Iridium sought to control, internally and externally, in the intermingled realms of technology, politics, and culture and in what ways they were consumers as well as producers of the zeitgeist. Embedded in this characterization is the question of a multinational corporation's relation to the state, of Motorola to the US government, and of their conjoined interests.

The Iridium Story: An Outline

In its most superficial guise, the Iridium story is engagingly Hollywood—it has a beginning, a middle, and an end and a second chance; it has vision, ambition, risk, luck, failure, a global stage, a cast of thousands, former enemies reconciled and making nice, and shadowed connections between the military and the commercial. Among its creators and implementers at Motorola and Iridium, the venture was not only a business opportunity or a job, but as the opening quote from Iridium Chairman Robert Kinzie suggests, it also was an ideal, in synch with the ambitions and enthusiasms of the time. Not surprisingly, it found support from President Clinton's administration, especially from Vice President Al Gore, a proponent of the Information Superhighway and communications advances generally.[25] The venture's rise, fall, and partial resuscitation neatly bracket the Cold War / post–Cold War phenomenon, the boom and bust of communications in the 1990s and the less utopian, more politically fraught post-9/11 world. Viewed narrowly, the story begins in 1987 when three Motorola engineers, sitting in the company's military products division, sketched out a novel commercial venture: a global telephone service implemented through a constellation of low Earth orbiting satellites, ground stations, and handheld phones to provide digital, wireless communications. The idea was "sold up" the corporate hierarchy over a period of nearly three years, with the military division overcoming the doubts and resistance of Motorola's much larger and more important (in dollar and sales terms) commercial divisions. The "little guys" persuaded corporate leadership to make the project a priority, which led to the worldwide announcement described earlier. In a dry, heroic business sense, Motorola and the Iridium start-up

overcame a number of hurdles—gaining a series of national and international regulatory approvals for spectrum allocation and permissions to operate; acquiring several billions of dollars in financing from sources around the world; and organizing and implementing, by the reckoning of the participants and the press, one of the most complicated technical projects ever attempted. These obstacles and their surmounting by Motorola and Iridium signaled, emphatically, the market-sparked transformations taking place.

Successes in the political-media world were matched by accomplishments inside the factory. Satellites pulsed off the production line in late 1996 and early 1997—at peak manufacture a fresh satellite appeared every five days. During 1997 and 1998, rockets launched from Baikonur, Kazakhstan, Taiyuan, China, and Vandenberg AFB, California, began to place tens of satellites into a communications constellation. A 1997 IPO for common stock helped connect the enterprise to the mania for Wall Street and market wealth. A worldwide advertising campaign preceded commercial service, which began in November 1998. But the target markets for the phone—primarily corporate business travelers—did not rush to buy-in as expected. A slow-motion sense of failure—historic, business-school-textbook-for-years-to-come failure—unfolded at real-time speed.[26] Phone and service sales stayed paltry compared to projections, and in a few months the result was financially catastrophic. In August 1999, Iridium filed for bankruptcy and sought to reorganize, but eventually collapsed in late 2000. Motorola planned to de-orbit the entire constellation, bringing the enterprise to a spectacular, theatric, eyes-to-the-heavens finale. With encouragement from the US Department of Defense (DoD), a new investor group edged in to buy the expensive system for pennies on the dollar—$20 million for the $7 billion system.[27]

This denouement looped back to the project's beginning in the Cold War: the DoD's push for new ownership in the bankruptcy process ensured the preservation of the system. With the system's worldwide, almost-anywhere capabilities, the DoD had an interest in Iridium from its conception, signed a multimillion-dollar contract when the system went commercial in 1998, and renewed and enlarged that contract in 2000 to help new ownership commit to a post-bankruptcy company. In the aftermath of the September 11, 2001, attacks on the World Trade Center in New York City and the Pentagon, Iridium (renamed Iridium Satellite in its reincarnated form, with all ties to Motorola and the original investors severed) enjoyed its best financial results, boosted initially by an increasing flow of military and other government business, as well as increased use by the media in covering the Afghanistan and Iraq wars.

Iridium as Historical Marker of the 1980s and 1990s Global

This overview description with its use of easily consumed traditional journalistic narrative devices mirrors, broadly, Motorola and Iridium's coverage in the media. Rambunctious optimism and fervor were leavened with occasional doubt and caution, but both notes rode an overt sense that technology, entrepreneurship, and markets were remaking the world. Such narrative, while obscuring more than it revealed, was part of the reality of the period and an essential ingredient for those at Motorola and Iridium. It provided a source of meaning and orientation, filling in the blanks in their own perception of their effort and their role in post–Cold War culture. In good postmodern fashion, the relentless ubiquity and circulation of media-generated concepts and tropes created a reality that the venture internalized and made part of its self-conception, and, in turn, redirected outward as it promoted its effort to the world.

As pervasive and important as this rhetorical field is to the Iridium story, it is not sufficient to understand the material conditions of the project—the interplay of knowledge, resources, and institutions. It is in these details of the venture, in the specific ways in which technology, culture, and organization intersected, that we might gain insight into distinctive aspects of the 1980s and of the transition from the Cold War to after.

One claim (and strategy) here is that the ideas of the project and the "start-up" are useful in tracking these developments. As with defining Cold War endeavors, the project in Iridium was an institutional space, particularly in its engineering dimensions at Motorola, in and through which the details of the technological and the details of the cultural were correlated, joined, and given meaning. Iridium drew directly on this prior history, using the project to similar effect. Fundamentally, a World War II and, especially, a Cold War invention, the project (exemplified by such undertakings as ballistic missiles and the Apollo program) was the preeminent tool by which the mid-twentieth-century state organized technical and social resources. In a pluralistic society, with distinct social spheres, the project, based on contract relationships, served to draw together disciplines, knowledge domains, and institutions, often geographically dispersed. It became one of the principal modalities for constituting the military-industrial-academic complex.[28] Its modus vivendi was thoroughly instrumental: to produce the means (the edifice of the project) and the end (a particular result, usually technological). The vast amount of government dollars that flowed through projects (compared to the pre–World War II period) made them sites of transformation.[29]

In the transition from the Cold War to after and in the broader 1980s preference for corporations and markets, rather than states, to serve as organizers of the technological and social, how might we see the project? Was it still a form, a political-organizational instrument, which had similar import? In its day-to-day activities, how did technological choice and practice intersect with the domains of business, culture, and state interests?[30] How was it adapted to a neoliberal market world?

For this latter question, the concept of the start-up was crucial to the venture, emblematic of 1980s and 1990s market neoliberal ideology. Such terminology indicated not merely a new business undertaking, but one that implied a boldness of ambition, a willingness to push against conventional wisdom, advanced by a small entrepreneurial nucleus, spurred by the possibility of large-scale market success. Start-up talk and practice was primarily attitudinal, grounded in the new circumstance of a geographically expanded market world.[31]

Iridium, with its origination in Fortune 500 Motorola, was a variation on this theme, capturing the attitude but benefiting from the resources of a large corporation. The latter was exemplified by Iridium's establishment as a corporation and subsidiary of Motorola under Delaware law in 1991. Still, the small initial Iridium cadre reflected the start-up vibe. As Mark Gercenstein, head of marketing, noted: "We met almost every day and we tackled all the problems and everybody did everything. If you needed help on sales, people did sales work, and if you needed . . . someone to write up a proposal for spectrum allocation, people did. There was this tremendous—I've never seen it since, but there was this, like, desire to achieve objectives. And it didn't matter who got the credit, who didn't get the credit, and who was leading it. Just people did things. If you could contribute, you did it."[32] By 1994, after the first infusion of investor equity funding, the venture shifted to a more conventional corporate organization. Yet Iridium's conjoining of the organizational forms of the project and the start-up fit the historical moment, bridging Cold War and neoliberal political economies. A subset of Motorola's defense unit provided the managerial and engineering expertise for defining, designing, and building the system under contract to Iridium the start-up. This arrangement emulated with a commercial, self-referential twist the basic formulation of the Cold War project—a rough separation, at least on paper, between a project and the political and funding environment of which it is a part. In turn, Iridium the start-up served as the means to establish the venture as an exemplar of the post–Cold War neoliberal order.

In the earliest phase of the project the market-oriented question "Will it be

profitable?" was balanced with the techno-organizational question "Could it be built?" And the basic resource in answering the latter was knowledge of the techniques and practices for implementing big technology projects—questions of management and process. By the end of the 1980s, this set of skills, the crucial underpinning of Cold War big technology, had become a codified, oft-used engineering and managerial specialty within government and high-technology industry. Sprawling, hybrid, complex projects, once novelties requiring special exertion, now were regarded as potentially challenging but readily subsumed into standard procedures.[33]

Iridium connected to this prior experience through two channels. One, just noted, was the project's origins in Motorola's defense service division. This division, as with similar divisions in other firms oriented toward commercial product lines, primarily subsisted on government contracts. In the case of Motorola, the DoD, the National Security Agency, and NASA were key patrons and it was the prospect of diminishing government dollars that spurred this Motorola division to contemplate reinventing itself for the commercial world—a recurring and familiar story throughout the Cold War as the availability of contract dollars cycled through highs and lows. The other channel linking Iridium to the project tradition was through personnel who joined the project. Several of the key people who managed the system design and manufacture and cross-institutional coordination and contracts came from similar roles in the US Air Force, a demographic shift of expertise from the state to the market at the end of the Cold War.

But Motorola adapted this legacy in key ways, reflecting intertwined conceptions of markets, the global, and the technological. Because Iridium's engineering cadre now was more attuned to Motorola's larger commercial program of work, the new venture, in contrast to Cold War methods, took market-centric values, norms, and attention to culture as essential to the success of the project. Such preoccupations derived from the global competitive challenges of the late 1970s and 1980s, and Motorola's presence in multiple nations and markets. As these thoughts outline, conceptualizing the global involved a triad of relationships: of Motorola as a multinational firm, redefined by its 1980s adaptation to transnational economic challenges; Iridium as an engineering project within the firm; and Iridium as a separate business start-up. The first two enabled the distinctive feature of the third: its direct presumption of the global as a defining condition.

As a commercial engineering undertaking, though, the project was not a cross-institutional, cross-disciplinary tool to advance the state of technological art or scientific knowledge. Iridium explicitly was conceived to use underlying

technologies that had proven their workability—although the system might use such technologies on a new scale (for example, on-satellite switching processors for directing calls around the network) or in new applications (such as phased array antennas—a crucial technology in establishing cellular communications between the satellites and the Earth's surface that only had been used in Earth-based applications previously). This was to ensure greater predictability and control over costs and schedule, and thus to reassure potential investors that the project could provide a return on capital—an explicit contrast with the history of state-sponsored, Cold War projects that almost always exceed expected costs and development times.

This view derived from Motorola's history. The company, established in 1928, pursued both commercial and defense work during the Cold War and by the 1980s had facilities in more than 40 countries, highlighting the question of the relationship of US value systems with those in other political and cultural settings. The interrelated focus on individuals and culture in Motorola derived from such international experience and specific trends and experiences that occurred during the 1970s and 1980s: a shift toward deregulation in trade law and communications policy; the increasing role of transnational companies in shaping global markets; and the Japanese manufacturing challenge in electronics and automobiles—a challenge Motorola directly confronted in its semiconductor business.[34] In the United States, the competitive success of Japanese firms gave rise to a simple, powerful equation that revolved around the nontrivial concept of "quality": Japanese companies produced products of superior quality; that quality derived from cultural factors inherent in Japanese business methods and in Japanese society; US corporations produced products of lesser quality; thus, US corporations, had cultures ill-adapted to a market-centric world. A key response was to elevate culture as a corporate preoccupation. In anthropological terms, the missing element was a shared system of symbols and practices that conceptually and emotionally tied together individual employees, practices, corporate goals, and international markets.[35] Considered against the background of the Fordist business model, many large firms saw cultural ill-adapted-ness as a problem to be analyzed and solved. One result was an eruption of new managerial methodologies that promised a remedy: Continuous Quality Management, Total Quality Management (TQM), Theory Z, and more.[36]

The project in its commercial expression thus saw individuals, institutional culture, and technology as new domains for theorizing and experimentation. A focus on process and quality provided a detailed frame for adapting individual

behavior and work and institutional culture. Such adaptation, it seemed, was the pathway to global market success, the means to control and link the myriad discrete actions of the project into a high-quality big technology whole, to make the local into the global, to envision control of a project on a transnational scale. And the perception that Motorola could indeed implement this culture-oriented mode of project management served as a resource for Iridium as well. In the wake of the competitive challenge from Japan, such a conceptualization of the project was regarded as essential for a global market undertaking. Indeed, the project thus conceived served as a crucial indicator that Motorola—and perhaps only Motorola—could pull off this initiative.

But process, quality, and culture were not abstractions in corporate life. They were central to a rethinking of corporate-specific knowledge production and translating that knowledge to employees, thus making the adaptation to globalization substantive not merely rhetorical (as managerial fads such as TQM seemed to imply), a set of micro- as well as macro-responses. Through the 1980s, Motorola developed various strategies for gaining control over domains of knowledge deemed as relevant to globalization, organized around questions such as the following: How does one define process or quality? What methodologies might enhance those ends, and how does one inculcate such knowledge in employees? The culmination of these efforts was the establishment in 1989 of Motorola University, whose purpose is discussed further in chapter 2. But the point here is to indicate that globalization was not merely about the scale of markets, trade flows, or flexible production, but also about reorganizing the knowledge relations in which the corporation was embedded. Adopting the moniker "university" for this in-house effort was a signal of both the need for certain new kinds of knowledge and pedagogy in the corporation and a changed attitude about the corporation's relation to outside sources of knowledge, especially academia.

Concepts of the global at different registers were inextricably bound up with Iridium in its several organizational manifestations in Motorola, together serving as a marker of a change in the period. The "global" as a conceptual category and "globalization" as a process have a history as old as the movement of peoples and the development of trade but only took on its contemporary theoretical connotations beginning in the early 1970s.[37] But in this latter context, Iridium as an exemplar of the global stands out in an obvious, important regard: as an initiative of a US-based multinational. Globalization in this period was not a diffuse, homogeneous process, but one grounded primarily in the West, especially in the United States. It, as the critical theorist Fredric Jameson offered, "may be said to

be the first specifically North American global style," reflecting the United States' geopolitical position and, with the turn to markets, the enhanced latitude of US multinational corporations to act across the world stage—circumstances that have reinvigorated analyses that use "empire" and "imperialism" as conceptual tools to understand the period's steering forces.[38] Iridium was inseparable from this US-preeminent, global market-shaped world.

As a symbol, Iridium was patently, almost tangibly global. The satellite constellation, with its 6 planes and 66 craft enmeshing the Earth, seemed, in artists' conceptions created for describing and promoting the venture, a striking, easily grasped image of the global in juxtaposition to the Internet's hidden mechanisms for getting communications from here to there. Those in Iridium dubbed the constellation's enclosure of the Earth the "cage," neatly capturing a taming-of-nature by subsuming the planet within a "24-7, anywhere," single technological system.[39] The constellation thus directly conveyed an image of technology enabling control of distance and time, of human dominion, of the possibility of an interconnection between any two points on the globe.

Too, as discussed in part above, Iridium became infused with and amplified the transcendent rhetoric of liberal democracy and markets. In this conceptual frame, all individuals shared a common essence and aspirations—to be discrete and independent political and economic actors. Individuals thus were defined not by the particular circumstances of their lives but by a transcendent template—the empowering ideals of the Enlightenment, which now found additional meaning in promoting and justifying global markets as the means for the realization of inalienable human rights. For market advocates, the global thus served as the next evolutionary step in the Enlightenment's fulfillment, to gain broad acceptance of individual-oriented, market-centric practices.[40]

One illustration, to be discussed in depth in chapter 4, highlights this end-of-the-Cold-War conflation of ideas. In 1993, after private investment had flowed into the venture and several important regulatory and engineering hurdles had been cleared, Motorola University jointly undertook with Robert Textor, an anthropology professor at Stanford University, a study to examine the many perceived ramifications of Iridium. They issued a draft manuscript in 1994 modestly entitled "'What Hath God Wrought?': Anticipating the Human Impacts and Sociocultural Implications of the Iridium Revolution" (later retitled "The Iridium Revolution"). Consisting of 77 propositions (reflecting the atomic number of iridium, rather than the reconfigured 66-satellite constellation), the authors foresaw the new business venture recasting cultural structures large and small—creating

change in "every major technological and economic realm"; enhancing individual autonomy; allowing the "illiterate and semi-literate" to communicate across vast distance and petition political leaders; providing a boon to militaries and, alas, insurgencies and criminals; transforming disaster and humanitarian relief missions; and, charmingly, lowering property insurance rates.[41] The conflation of the individual as a liberal democratic political actor and as a participant in markets was evident throughout, as seen in this proposition:

> 67. Along with the mass media, Iridium will widen people's awareness of possible alternative political, economic, social, and cultural arrangements—which in turn will result in visions of, and pressures for, more political freedom, higher living standards, wider social opportunity, greater tolerance of social deviance, and a wider range of choice in cultural participation and consumption.[42]

The exercise suggests something of the scope of Motorola University's interests as well as the close alignment of ideology with Iridium.

These broad ideological strokes were not the only manifestations of the global in Iridium. The project, not surprisingly, invoked or grappled with the particulars of engineering (in both senses of the term) the global. As the venture developed, it maintained a careful ambiguity on whether Iridium was a mass-market product (the implication of the "'What Hath God Wrought'" document) or pitched itself at a more specialized niche.[43] Indeed, Iridium was conceptualized and designed in its technical specifications to serve a very particular class of users—international business travelers, especially those from the United States, Europe, and Japan, on the move to developing countries and in need of anywhere communications. Though such conceptualization provided an overarching rationale, the engineering effort required a highly specific scenario of use to develop the system's technical details. As will be described more fully in chapter 2, that scenario was nonobvious: the system would have to enable a voice transmission from inside an automobile as a caller traversed from an international airport to its adjacent metropolitan area. This scenario reflected a technical challenge (a signal strong enough to penetrate an automobile) and the expectation that global travelers would want to be connected to work or home soon after deplaning. The entire technical specification of the Iridium system was designed to meet this scenario, which, in turn, determined every other facet of the system—the numbers of satellites, their size, their power, their antenna design, all grounded in a particular conception of global business practice, then and in the future.[44]

The foregoing suggests the degree to which global business practice and the

idea of the global were constructs that were in process, contingent. This sense of contingency also played out in the legal and regulatory arenas essential to the venture. When Motorola announced Iridium in June 1990, there did not exist a regulatory framework that could legitimate the enterprise. In the tightly regulated world of radio communications no spectrum had been allocated for satellite cellular service by the appropriate national and international regulatory bodies, and no specific authorization had been given to Iridium to provide such service. The necessary political acts had to be negotiated and constructed through national and international regulatory bodies, then through each individual country within which Iridium planned to operate. Thus, the venture became defined by the effort to embed it in a yet-to-be-created legal and regulatory framework, helping in the process to create particular notions of the global. The period turn to deregulation and markets also facilitated Iridium's competitive position by weakening the protected status of the Cold War, UN-authorized International Telecommunications Satellite Organization (Intelsat) and the International Maritime Satellite Organization (Inmarsat) (that facilitated, respectively, satellite communications to land masses and on the oceans). Iridium also found accommodation in the mid-1990s discussions establishing the World Trade Organization (WTO). Both Motorola's political sway and US government support helped secure these elements of a new market-oriented, global framework. Ideology, engineering, and these extra-market political acts existed as a tangled whole in Iridium, mutually defining the venture and, in selected fashion, the emerging world of the 1990s global.

The global also manifested itself in the business particulars of Motorola and Iridium. As noted earlier, prior to Iridium, Motorola had plants and sales offices in tens of countries and had already established working relationships with government officials in most of the countries from which investors came. These preexisting relationships served variously as symbol of Motorola's standing as one of the world's vanguard high-technology companies and as an in-nation resource for negotiating support for Iridium. As Iridium started, these Motorola relationships became entwined with a key organizational feature of the venture. Most investors, in return for providing equity, also acquired the right to establish a "gateway" in a given geographical area, As a prosaic matter, a gateway was a technical construct, connecting the satellite system to the public-switched telephone network. But, equally important, it served two other critical purposes—as a vital political node in creating a global market for Iridium and as *the* site through which profits would be generated. The gateways' performance, thus, would (and

did) become a key determinant of the fate of the enterprise. This structure raised a key question: could, in this historical moment, Western business values be effectively joined with the distinct local political and business cultures of places as diverse as China, Russia, Brazil, or Saudi Arabia? This issue proved to an unresolvable fault line, an underlying reality of the venture's "united nations."

This roadmap summary of 1980s and 1990s preoccupations with the global and related concepts and Motorola and Iridium's intimate involvement therein provides the basis for this account. It seeks to follow these historical actors as they grappled with the problem of the global. How did it get expressed at different scales, from individuals on the factory floor, to Motorola and Iridium as corporations, to their relations to the US government, to transnational forms of governance and organization? How was it given particular form through the overlapping trajectories of engineering, business organization, and marketing and ideology?

Chapter Two

The Global and the Engineers

> The aerospace industry told us we were nuts. "How are you going to get all these satellites up in a short period of time? Motorola, you're not a satellite manufacturer. You don't know what you're doing. You've got all these inter-satellite links. You'll never make that work. You guys don't know what you can't do." This, that, and the other thing. We proved them wrong.
>
> RAY LEOPOLD, ORAL HISTORY INTERVIEW

The story of Iridium is inextricably bound to its origins—as the brainchild in the late 1980s of engineers sitting in the Government Electronics Division of Motorola, a Fortune 500 company operating in tens of countries and then one of the world's preeminent communications firms. This division's work primarily was devoted to communications programs of US military and intelligence agencies but also included work for NASA, with such combined effort representing a small slice of the larger corporation's predominantly commercial portfolio. The timing of the venture mattered as much as the corporate context and the juxtaposition of military and commercial expertise. In 1987, the Iridium "eureka" invention moment, the ramping up of a transnational market ethos was well under way and the decline of the US Cold War complex, at least as measured in appropriations dollars, was evident.[1] In this fluid context, the engineers had several options to develop the ambitious idea of a space-based global cellular network: in the familiar mold of a Cold War undertaking, or as a leap into the market, with its different demands and uncertainties, or as a hybrid of the two.

In the next two years, the project remained an in-house undertaking, moving from a raw idea to a possibility supported by engineering details and a first-blush business plan. In an instance of storybook historical confluence, Motorola's top management, led by the founding family scion Robert Galvin, committed the company to developing the Iridium idea on November 9, 1989—the very day that East Germans, responding to a dramatic loosening in government strictures on travel, flooded into West Berlin, bringing down the Berlin Wall and the rigid geopolitics of capitalist and communist confrontation.[2] This historic event, quickly

leading to the collapse of the Soviet Bloc, gave added emphasis to the perception that market and liberal democratic ideologies were to be the dominant organizing principles of the late twentieth century. These events, in turn, were entangled in period actualities and rhetoric on the emerging Information Society, with its implications for vast change from individuals, to local communities, to the global—and, not least for this narrative, the perceived need for corporate adaptation to this new condition.[3]

The possibility of opening the Soviet Bloc's geographic domain to neoliberal sensibilities emphasized, too, the spatial assumption of globalization—that the entire planet should be open to the flows and connecting infrastructures of the market. After 40-plus years of the Cold War, this catalytic change brought forth in the United States and Europe a burst of heady, utopian-tinged politics and emotions. Advances in communications—cellular telephony, the emerging Internet, undersea fiber-optic cables—and their association with Enlightenment-style individual empowerment seemed to give substance to such enthusiasm, especially in their promise of easy, pervasive communication beyond and across national borders.

With Motorola leadership's imprimatur, Iridium emerged from its gestation perfectly in synch with the historical moment: a project defined by and defining of a world turn to markets and of the assumed naturalness in seeing the entire planet as a field of action. Each of these characteristics aligned fundamentally with the dominant contours of US politics and power in the period, in which concepts such as the Information Society and the New Economy (which the former enabled) highlighted the means by which the United States might sustain its preeminent post–Cold War position. Not least, too, the project, embedded in a Motorola division specializing in military and intelligence projects, embodied the question of how, in this new post–Cold War, lone-superpower world, national security and market interests might fashion their relations.

Shaping the Engineering Enterprise

In the engineering effort, such relations took specific form. The Motorola engineers at the core of the project married Cold War big technology skills to a late 1980s and early 1990s transnational market landscape, now more hospitable in more geographic locales to capitalism's possibilities. This relative shift to markets as the driver of geopolitics was reflected in Iridium's technological design. A user of an Iridium phone could connect with the space-based system and call anywhere in the world without any technical intervention from the ground. This

served the idea of a borderless world of markets but ran if not against the grain of the nation-state-centered geopolitics of the Cold War then at least in contrast with it. Much of the work of Iridium (the start-up company, formed in 1991, in distinction from the engineering project) centered on finding accommodation between the border-erasing implications of markets and technology and the border-defining prerogatives of individual nation-states.

Iridium's design, too, reflected the fact that the market and national security interests in this period were neither mutually exclusive opposites nor segregated areas of activity. Especially in the field of satellite-based communications, overlap and accommodation was becoming the rule rather than the exception. The technical features of the planetary-spanning Iridium thus fit neatly into governmental (primarily military) interests in communicating anytime, anywhere, a legacy of decades of a Cold War in which every spot on the globe was deemed to have geopolitical significance. The relation of Iridium to this "market" remained a subsidiary but important part of the venture through the 1990s and 2000s. It was this common value to markets *and* national security that made Iridium emblematic of the post–Cold War period.

Motorola leadership, partly for these reasons, chose to leave control of Iridium with its originators, but giving it the status of a special project reporting directly to top company management—a marker of how the endeavor fit into the corporation's vision of its future. In the first several years, the company's government subdivision drove the effort, elaborating the design, creating the in-house organization, and working with corporate leaders to develop the financial and legal framework to establish the business as a global enterprise.

Notions of how best to balance technological choices with the aim of a for-profit endeavor shaped the project. The idea of a low Earth orbit space-based communications network, global in extent, was technically ambitious, especially as to scale, and the subdivision proposed a several-year time frame to achieve operation. But the project eschewed ambition in one noteworthy regard: it did not aim to stretch the state of the art in engineering. The pragmatic aim of making profits (and thus moving as quickly as possible from concept to operational reality at a fixed cost) pushed managers to prefer "known" technology rather than seek "sweet" but untested innovations.[4] Such a context, though, did raise a "make or break" challenge: process—the problem of defining, coordinating, and streamlining the many steps in building a complex system with time and profit as driving concerns. To create in a few years an Earth-encircling communications system and operate it was an unprecedented feat in the annals of spaceflight—a

point of pride captured in the opening quote from the Iridium co-inventor Ray Leopold. As a project that self-consciously placed itself in the vanguard of the transition from a Cold War to a market world, Motorola engineers saw defining and elaborating a new-style manufacturing regime and work culture as their distinctive professional contributions.

This chapter focuses on the Motorola engineers and their development of Iridium, covering the years 1987–1998. Throughout the venture, the engineering aspects of the project maintained a distinct identity, even as they overlapped and interacted with the concomitant tasks of creating the political, financial, and regulatory arrangements necessary to the project as a business venture. This distinctiveness was codified in the business structure linking Motorola as the parent and Iridium as the subsidiary during the 1990–1994 period. Iridium paid Motorola through a contract to build the satellite system. But it was the Motorola engineers who provided the expertise to write the contract and who played an active role in selling the venture to potential investors, whose financial equity flowed then into Iridium the company, which, in turn used those funds to pay Motorola for its engineering and manufacturing work.

As creators of the Iridium idea and shapers of its realization, the engineers also were the emotional and spiritual center of the project, those most deeply committed to deploying technology and market-based methodologies in pursuit of a global ideal. For many on the project, as with Apollo engineers in the 1960s, Iridium, in its combination of scale, complexity, ambition, and intensity of effort, stood as the highlight of their professional careers. Working on the project thus was not merely a sequence of engineering challenges, but an experience infused with the idealism of fashioning a world-embracing communications system that had the potential to reorient the contours of global life. One engineer offered that the project had two animating motivations. One was to "bring personal communications within the reach of every human being in the world"; the other was to "produce a new product with never before achieved development time, cycle time, quality, and cost."[5] These two goals need not have been linked, but they were a reflection of the historical moment. Thus, abstractions such as "cycle time," "process," or "organizational culture" were not merely abstractions, but instruments whose meaning was bound up with achieving Iridium's global ideal.

Such conflation of work and idealism had various roots. Not insignificant was that these engineers sat in Chandler, Arizona, 30 miles south of Phoenix, part of a complex of Motorola facilities in the larger metropolitan area. Situated away from the space manufacturing centers of the West Coast and the political nexus

of Washington, DC, gave the project a reactionary flavor, of taking on challenges at which established players might hesitate. It also stood in contrast to Silicon Valley, the epicenter of the computer and Internet revolution. It drew on the same political and cultural resonances attached to information and its technological expression, but as a large infrastructure project originating in a large, well-established corporation it had a more conservative feel.

In a flat, rural area, dotted with irrigated cotton fields, Motorola's Iridium effort seemed a vision from the desert. As the venture staffed up from a few to tens to hundreds to several thousands, its aura of idealism was not one-noted. Some engineers felt strongly about the project's moral vision, of placing "solar-powered phone booths into villages in Africa or remote regions where people didn't have communications or emergency services." Others, especially those whose work had been in various domains of national security, felt the historic nature of the end-of-Cold War geopolitical moment, of "beating swords into plowshares." Such feelings were amplified by a key aspect of the venture: the use of Russian and Chinese launch vehicles to help place the space constellation into orbit. From 1991 into 1998, engineers traveled into the symbolic heart of their Cold War adversaries, the launch facilities at Baikonur, Kazakhstan, and Taiyuan, China. For example, Ted Kehl, a former colonel in the air force who worked on strategic missile programs, joined Iridium and traveled to Baikonur as part of early discussions on Russian participation in the venture. As relayed by Mark Gercenstein, Iridium's primary contact with the Russians, Kehl "was walking through the factory that built SS-19s [a Soviet ICBM] and he was totally blown away. He said, 'I spent my whole career working against this threat, and here we're drinking vodka together with the guys who a year ago were assembling these things.' It was a huge [shift in] mindset for these guys."[6]

Others were drawn to the geeky difficulty of creating a never-before-attempted global communications system and doing it in a few years. That Iridium was to be done under the banner of the market, open to the excitements and scrutiny of a news media keen to report the wealth of advances in communications technologies, only intensified such motivation. These threads, of course, fed into the ambitions of the top managers in the effort, keen to create the foundation of a new global business for Motorola.[7] Such exceptionalism created a strong sense of community, which, in turn, became essential to the engineering enterprise and of the success of the satellite constellation as a technical system.

The engineering effort touched selectively on the larger sphere of politics involved in Iridium as it developed in the United States, multiple national con-

texts, and international forums. In the engineering cohort, only the leadership—key individuals such as Durrell Hillis, Bary Bertiger, Ray Leopold, and Marc Gercenstein—were prominent in building out the formative engineering idea into a global business endeavor. Such involvements were focused and concentrated in the early years of the effort, especially as to seeking US and international investors and applying their expertise in the crucial arena of gaining regulatory approvals at the Federal Communications Commission (FCC) in the United States and at the International Telecommunications Union (ITU). Once these early-year hurdles were surmounted, the focus narrowed to building out the system.

The engineering group thus provided in the earliest years the conceptual, professional core of the enterprise. It was inextricably bound to Iridium as a separate commercial venture through expertise and, especially, contract. This latter structural arrangement, not surprisingly, gave the engineering group and Motorola significant leverage over its start-up, but imposed a significant commitment to deliver on their technical promises.[8] Yet, as suggested, this multifaceted role was bounded. Despite the intimate connection between the engineers and Iridium the business, it was the latter (often in alliance with Motorola corporate) that confronted the broad, messy scope of national and transnational politics and regulatory issues—and thus tended to see the effort in politically pragmatic rather than idealistic terms. The engineers, though not removed from the complicated politics of the venture, were more distant from it than those in Iridium's other organizational contexts. The result was that the global as ideal occupied a greater prominence in their work life, shaping the very character of their effort.

Once the basic concept of Iridium had been articulated, project engineers confronted one fundamental question: how were they to develop a global space-based technological system, get it into Earth orbit, and then operate it with the reliability and quality necessary for an ongoing communications business? The answer had two, interrelated parts: the concept of "process," already mentioned, and, its embodiment in an organizational metaphor—the idea of a "virtual factory." Arrived at as Iridium developed, the phrase came from the manufacturing design group tasked to take a broad view of methods required to execute the project. The virtual factory and process thus were twinned, mutually supportive concepts that sought to relate design, manufacturing, and global scale.

This "factory" did not, of course, exist in the brick-and-mortar sense of the term; Iridium's activities were neither geographically concentrated nor institutionally monolithic. Rather, as a matter of technology and politics in a global system, the project was composed of a variety of independent entities dispersed

across the international landscape: in the United States, Motorola, Raytheon, Lockheed, and a host of contractors; outside the United States, launch facilities in Baikonur and Taiyuan; software contract work in India; and a back-up satellite control center in Italy. But the idea of the factory did perform specific work. It conveyed that all these entities were bound together in the project through contract and information pathways, and, more important, that within the factory "walls" a shared view of community and common purpose held sway.[9]

This view centered on the meaning and centrality of process to the enterprise —a shared set of technical practices, embedded in a market-oriented view of the world, requiring a particular set of managerial and employee behaviors and commitments.[10] And process was a means to an end: quality.[11] The goal was to establish a project way of life that could be transported and replicated, albeit with difficulty, to disparate institutions and cultural sites, to make quality, as one engineer put it, "robust," highly resistant to variation.[12] Such an aim strengthened the idea that the project established new social boundaries, drawing in and redirecting elements of other institutions, into a new, substantive community dedicated to the production of a space system in several years at fixed cost. In the context of globalization and a market-driven endeavor, process (means) and quality (end) were, respectively, the critical method and output of the virtual factory. For the Motorola engineers at the center of the project, this metaphor, sometimes explicit, sometimes implied, was the essential building block for undertaking a global venture—to create a transnational structure that drew in diverse resources but sought explicitly to bind them together in a common identity and culture.

This structure, informed by a specialized language and intellectual commitments, was a response to developing Iridium as a commercial for-profit activity —in direct contrast to the big technology projects done under Cold War state-sponsored auspices, and thus a reflection of the intimate connection between market-based action and the global in the 1990s. The technical aspects of the project were defined by the absorption and redirection of Cold War technical methodologies (particularly organization and project management methods) into market-based methodologies and their attendant preoccupation with values. The latter came into the project through Motorola's competition in the semiconductor and consumer electronics markets with Japanese firms in the 1970s and 1980s—an experience that elevated process, quality, and values as defining concerns and organizing concepts not only for Motorola but also for a large swath of US industry.

The company devoted considerable effort to learn and adapt "lean manufac-

turing" techniques, seen as the innovation that had, in particular, enabled Japanese automobile manufacturers to outperform their US counterparts.[13] Of equal importance, in the mid-1980s, Motorola invented its own quality control methodology called Six Sigma (of which more will be said later).[14] As these remarks suggest, Iridium was bound to the larger context of Motorola, which as a multinational company was an active participant in the reshaping of transnational business in the years just prior to the satellite project. The idea of corporate reinvention as a critical, strategic necessity loomed large in the 1980s, resulting in organizational adaptations, the most notable of which established a "university"—Motorola University—to provide an in-house mechanism for training all employees in the methods and values deemed essential in meeting the demands of global competition. Motorola University was a prominent symbol of that reinvention and of the focus on analyzing and improving process as a necessary concomitant to the condition of globalization. Such a focus, corporate leaders believed, was as critical to corporate success as new products or fundamental engineering concepts. Iridium's organizational and engineering ethos actively drew on and mirrored this context.[15]

Such thinking and practices informed Iridium managers' belief that the mix of individuals and institutions represented in the effort, coming from distinct engineering traditions, could be made cohesive through shared concepts of work, behaviors, and specific modes of knowledge—in short, by creating a culture that embraced all these elements. Through this concerted corporate dedication to process, military and commercial elements of Motorola could be conjoined, as well as organizations with their own, deeply rooted and different ways of doing, including Cold War firms such as Lockheed and Raytheon. Iridium also became home to an influx of individuals from Apple, commercial aviation firms, and telephone companies. In the world of the market and the global, engineering practice in the project became—through the concept of process—its own distinct problem, one requiring concerted, ongoing attention. The result was an actively crafted, transnational, trans-institutional methodology, a blend of technique and culture, shaped primarily by the imperatives of the market but using Cold War state-derived practices as a critical resource.

But "process" was a capacious term. What deeper concern did it represent for these historical actors? Seen through the lens of assembly or integration, it was to claim that the broad series of technical, organizational, and social interactions involved in manufacture had been undertheorized.[16] It derived from the historical moment of the late 1970s and 1980s: under the twin pressures of greater trans-

national competition and neoliberal economic policy the corporation needed to do more to make explicit or "characterize" the effect of these interactions on the final product, its quality. "Quality" seemingly provided a clear standard of whether a change in process proved effective (new process iteration "b" yielded a better product than old process "a"). But it was imprecise, too, as the question of which changes were fundamental to improvement was not directly addressed.

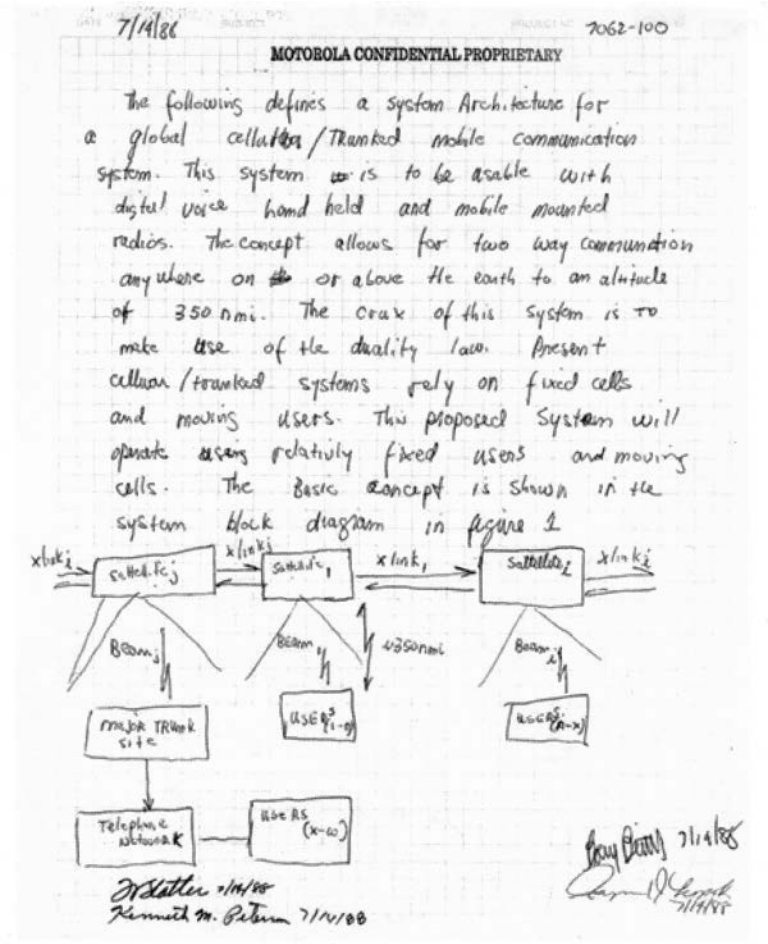
Perceiving manufacturing and the totality of the organizational relations in which it was embedded as a foundational problem thus did not identify what needed to be theorized or how. It was a problem domain of interrelated parts, spanning the technical, methodological, and cultural, touching multiple categories of knowledge, but which did not directly align with the disciplinary structure of the academy. Seen from this perspective, talk about process and quality was an overarching construct, which covered a range of ferment in conceptualizing the work of the corporation. These included seeking to understand the Japanese model, from workplace practices, to relations among firms in the supply chain, to the more slippery place of culture as a crucial source of market success. They, too, embraced quasi-faddish managerial enthusiasms such as Total Quality Management (TQM) that offered a meta-prescription of taking a deeper look at the composition of all organizational transactions. Motorola's manufacturing methodology, Six Sigma, too, was a key response to this broader problematic. As a response, it combined the use of statistical tools to measure the effectiveness of particular changes in process and cultural incentives to stimulate employees to think and live process as a central aspect of corporate life. Such framing also helps to understand the creation of Motorola University as a larger-scale answer to the perceived undertheorization of manufacturing and organization in the conditions of globalization. The need to aggregate and connect intellectual domains and methods, from the hard and social sciences, directly relevant to the corporation seemed paramount.

The Iridium engineers entered this flux. Though process, quality, and the virtual factory served as organizing constructs, the "what" and "how" of their definition and implementation was a moving target, changing over the course of design and development leading to manufacture. In part, this reflected the challenge of bringing forward what in Iridium needed to be "characterized," made explicit, to create a working system, developed on schedule. But it also reflected, as the 1990s began, the challenge of sorting through the efficacy of existing tools such as Cold War project management methods and Six Sigma and deciding in what ways they might need to be adapted or supplemented.

In exploring this story, two points should be made. The first is that an engineering project of this type proceeds in relatively clear stages, from an initial idea through a series of engineering design articulations, with successive layers of deepened detail, ramping up to manufacture, and, as a satellite project, to the launch and operation of the system. The middle portions of this sequence often overlap (and did in this case), but the effort embodied a clear narrative arc through which the engineers and Motorola leadership did their work. Though this narrative arc is present in this chapter, the focus is more on select themes that bring out the problem of the global of which the engineering effort was inextricably a part: the heightened role assigned to process and manufacturability, of their relation to Motorola University as a corporate space for organizing knowledge production, and of the prominent role that culture occupied in corporate thought. A second point pertains to sources. Much of the description and analysis here relies on oral history interviews with a range of project participants—an after-the-fact quasi-ethnography. This is, in part, because of the difficulty in getting access to relevant corporate records, but also because such interviews were useful for getting at workplace practices and culture—an aspect of the project that those in Iridium themselves saw as central to what they were doing and as one of their signature accomplishments.[17]

Origins of Iridium and Currents of the 1980s

Perhaps appropriate to the waning days of the Cold War and a US and European media increasingly fascinated with markets and technology, Iridium possessed two stories of its origins. One, often repeated in media accounts during the 1990s, was a classic account of innovation in which a perceived problem, inventors, and markets combine to yield the new. In 1987, Kenneth Peterson, Raymond Leopold, and Bary Bertiger, engineers employed at Motorola's Government Electronics Division near Phoenix, grappled with a problem posed by Bertiger's spouse, a real-estate agent in the region's go-go property market: "Why could you not make a cell phone call while sitting on the beach in the Bahamas to your office in the USA (or elsewhere)?" The family was contemplating a vacation and Mrs. Bertiger as an early adopter of cell phone technology (owner of a Motorola "brick") wanted the same capability in the Bahamas that she had in Phoenix. The question combined the burgeoning expectations for cell phone technology (then confined to major urban areas) with the emerging information-era sensibility of monitoring and executing professional responsibilities while engaged in leisure activities. In this version, the origin implicitly was a story of markets, not the Cold War.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MOTOROLA CONFIDENTIAL PROPRIETARY
The following defines a system Architecture for a global cellular/Trunked mobile communication system. This system is to be usable with digital voice hand held and mobile mounted radios. The concept allows for two way communication anywhere on or above the earth to an altitude of 350 nmi. The crux of this system is to make use of the duality law. Present cellular/trunked systems rely on fixed cells and moving users. This proposed system will operate using relatively fixed users and moving cells. The basic concept is shown in the system block diagram in figure 1
xlink1
xlink2
xlink3
350nmi
Beam1
Beam2
Beam3
major TRunk site
Telephone network
Kenneth M. Peterson 7/14/88

Figure 2.1. The 1988 concept statement for Iridium by the three inventors, Bary Bertiger, Ray Leopold, and Kenneth Peterson. Used with permission of Motorola Solutions, Inc.

Bertiger mulled the notion over and brought it to his colleagues. As Peterson recalled: "Well, Iridium was basically Bary's idea. He came in with this one-line idea. [Laughter] You could describe it in one sentence, you know, about a small satellite system to effectively have a space-based cellular radio system. It was just an idea, a one-line idea."[18] The three engineers sketched and handwrote the concept on a sheet of paper in 1988 (fig. 2.1), providing the basics of a space-based, global system of satellites to provide cellular telephone service to any point on Earth.

It bears emphasis that the idea from its inception focused on a complete Earth-embracing system—not on a component (such as a satellite), not on a service of limited geographical reaches (say, the United States and bordering areas). It presumed a system and concept of usage literally global in extent. In this classic American narrative of invention and entrepreneurial pluck, the idea gained gradually material expression, culminating in an operational system in 1998, the fruit of imaginative response to a problem, perseverance, business risk-taking, luck, and timing.[19] These graphics from the mid-1990s convey three perspectives of how the idea developed into an operational enterprise: as a stylized satellite constellation (fig. 2.2); as a cellular radiation pattern produced by this constellation over the entirety of the Earth (fig. 2.3); and as a communications system that allowed this space-based capability to operate as an independent communications network or to integrate with ground-based telephony systems, traditional landlines or cellular (fig. 2.4).[20]

The second origins story, derived primarily from oral history interviews with Motorola principals, reorients this lore, opening up the complex interplay among government agencies, corporate contractors, the shifting intersections between national security and commercial interests in the mid-1980s, and the role of engineering and engineers. The outlines of the heroic invention narrative are not incorrect. But the critical formative elements of the Iridium project emerged from its obvious and immediate context. The three Motorola inventors worked as part of a relatively small Systems Engineering Group situated within Motorola's Government Electronics Division devoted to contract work building electronic subsystems for military and intelligence programs primarily, as well as for NASA projects. The division was a small slice (approximately 8 to 10 percent) of Motorola's largely commercial portfolio, which then specialized in products that included semiconductors to terrestrial information networks, cellular infrastructure and phones, pagers, and radios.[21] The Systems Engineering Group had been created in the mid-1980s by Durrell Hillis, leader of the Government Electronics Division (and soon to be a key figure in Iridium's development), to look for new business concepts for government or commercial markets.[22] Hillis had experience on both sides of this divide. Before coming to the Government Electronics Division to oversee contracts with the National Security Agency, he worked in Motorola's semiconductor business. In addition to degrees in electrical engineering, he had an MBA, doing a thesis on automated manufacturing lines.

Hillis saw the Systems Engineering Group as an entrepreneurial device. It stood as a response to declining Cold War budgets, a trend that threatened to

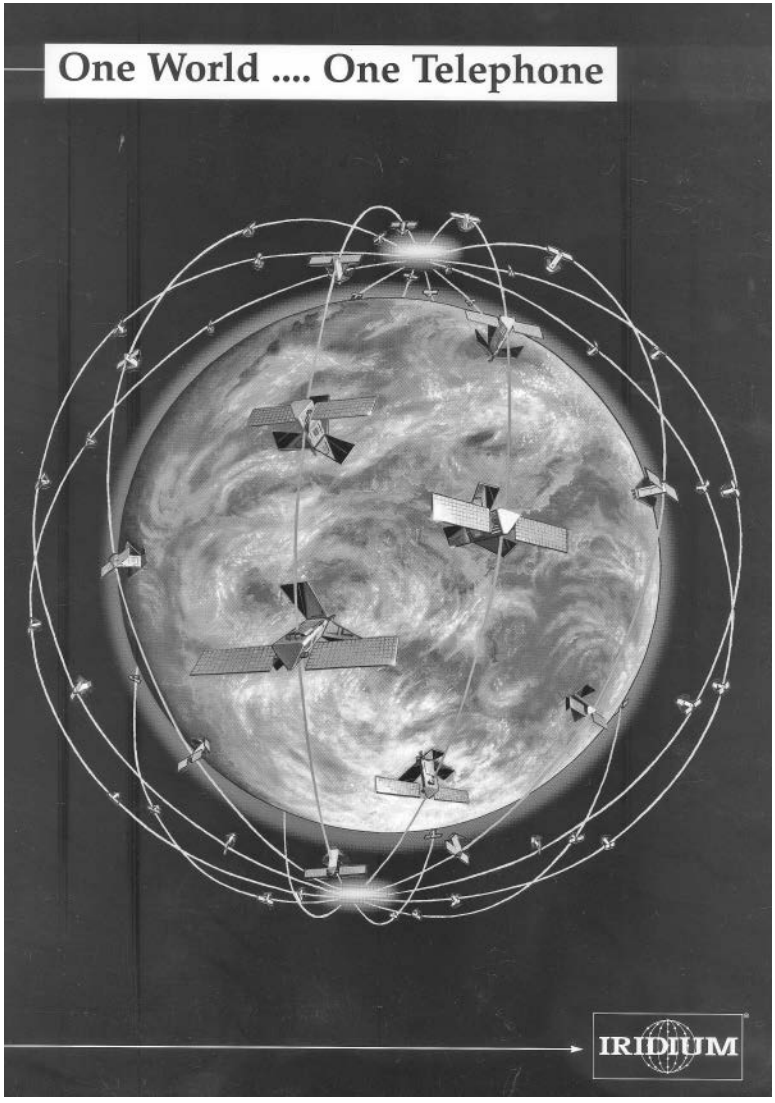
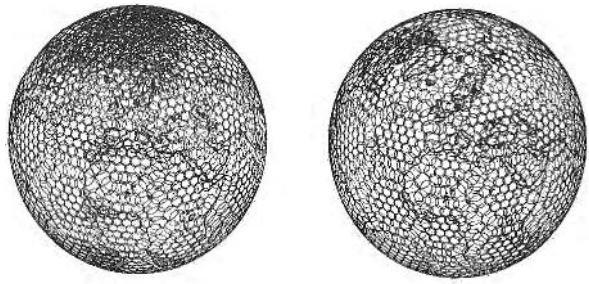


Figure 2.2. Artist's rendition of the 1992 redesigned planet-embracing satellite system composed of 6 planes, with 11 satellites in each. Courtesy of Iridium Satellite LLC



Constellation Beam Pattern with Redundancies

Constellation Beam Pattern without Redundancies

Figure 2.3. Cellular beam pattern produced on the Earth by the constellation of satellites. The cells cover the entire planet, including oceans and poles. Used with permission of Motorola Solutions, Inc.

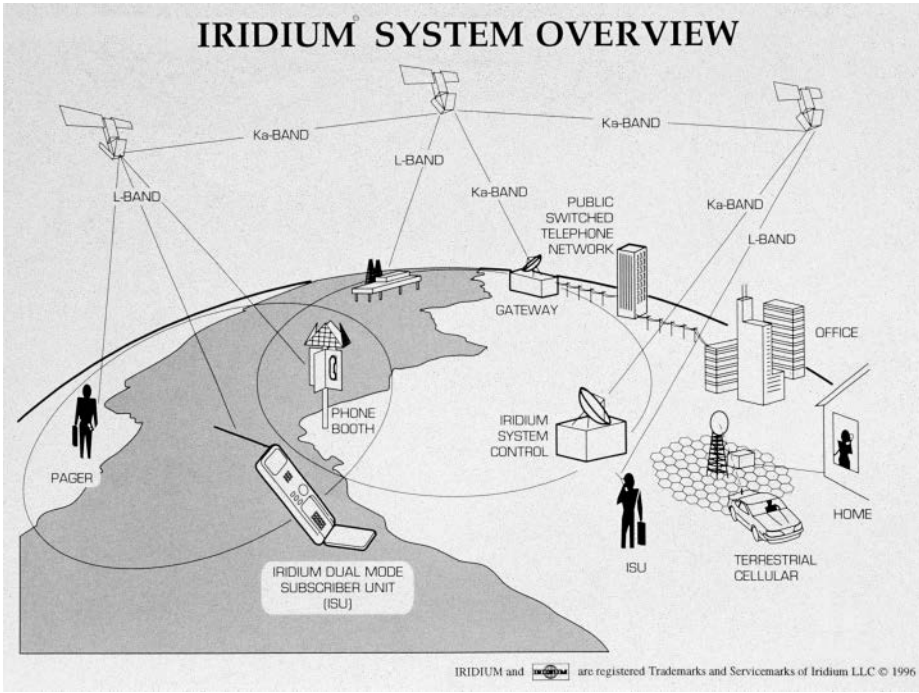


Figure 2.4. Note the circular beam patterns on the ground. Satellite radio signals interact with individual users, terrestrial cellular services, traditional switched networks, and the control system for the constellation. Used with permission of Motorola Solutions, Inc.

undermine the division's longstanding sources of support. It, too, reflected the period fact that the larger Motorola, commercially oriented, exemplified the competitive international environment of the 1980s: its challenges, its excitements, and the heady rewards that came from successful ideas and strategies. The group sought to see its minor status in the Fortune 500 company as an asset, an opportunity to connect its future to the company's varied and robust communications business. Whether their future lay with government support or markets, the capability they were promoting was perfectly (if bureaucratically) in their marquee: systems engineering, the knowledge and wherewithal to design, make, and operate complex aggregations of technology, institutions, and people. But the group aimed not at promoting an all-purpose capability but tying to it their main skill set in advanced electronics. In the context of the burgeoning communications market, this combination seemed to have significant promise.

This linkage of broad and specific capabilities became their focus for two reasons. One was the history of Cold War contracting for weapons and national security technologies, in which the idea of systems and systems thinking was a fundamental organizing concept. A system—whether centered on a ballistic missile, a bomber, a Space Shuttle, or a communications network—was the primary unit of contracting and of national defense and intelligence planning and budgeting. The systems idea, adopted with vigor in the first years after World War II, was, perhaps, the most consequential invention of the Cold War—in its effect on how national technical resources were organized and in the "iron triangle" politics it spawned.[23] Only a few companies had built up the institutional and professional skill sets to design, organize a multitude of contributing partners (which might be other firms, universities, or other research entities), and build a system. In the mid-1980s, these included Boeing, Lockheed, Martin Marietta, and a handful of others. The thousands of other companies in the universe of defense contracting filled a narrower role: to provide a specific component or subsystem that fit into a larger system.

Motorola's Government Electronics Division was comparable to one of these latter firms, but determined through the Systems Engineering Group to become one of the former, to become, in the lingo of defense contracting, a "prime"—indeed, placing "systems" in their title was to assert a higher level of ambition beyond their prior emphasis on subsystems. Primes, of course, could make more money as the organizing force in developing a system. But, also and importantly, they were invited to sit at the table with military and intelligence program heads and planners to brainstorm on how to define national security problems and

suggest the means by which they might be addressed. To be at the table, as a prime, was to enhance the possibility that one's contributions might translate into contracts and products. To move up the contracting hierarchy, though, Motorola needed to show it had the right skill sets within its organization. The electronics group had technical chops, as evidenced by a long record of successful contributions to government programs. The missing ingredient was engineers recognized by Department of Defense (DoD) program managers as having experience and proficiency in designing and managing large government systems. Motorola began to hire such engineers away from the existing primes, giving itself enhanced credibility for its aspirations.[24]

The emphasis on systems engineering and systems modalities for looking at the world also came from another angle. This engineering area, intimately bound to the related Cold War profession of "project management," largely took shape through the practical challenges and political requirements of developing weapons systems —as a discipline conceived around non-market, state imperatives and interests. Yet, as the field gained an identity during the 1950s, 1960s, and 1970s, as university engineering courses were developed and textbooks written, as industrial and government seminars proliferated, systems-tinged practices and thinking were seen as generic and foundational, as applying to any complex, heterogeneous technological undertaking.[25] In the 1960s and 1970s, several (and high-profile) attempts by aerospace firms, in particular, to take government-inflected systems and project management skills and apply them to market-driven projects ended up as flops.[26] The idea of generic applicability persisted—despite the deep rooting of these skill sets in the special conditions of Cold War military and industrial institutions. Generic, in this context, then meant something specific: to carry the panoply of Cold War project management and systems engineering practices into the world of the market and make them work.

Bary Bertiger, in particular, was enamored of this challenge—as an intellectual problem, as it pertained to the social boundaries within Motorola, and as a pathway to the larger monetary rewards of the market. At the time of his coinvention of the Iridium concept, he was chief engineer for Motorola's Government Electronics Division, a veteran engineer of numerous projects, and the holder of a variety of patents. Not least, arriving at Motorola in the 1970s, he was generationally positioned to know Cold War project methodologies and emerging new approaches to commercial manufacture. As Iridium began, he saw the essential task as focusing on the core purposes of system methodologies and tools. This boiled down to two precepts: "know where you are" in the complex

trajectory of a project, and "know your field of risks." These were the "primal facts" and a savvy manager used and adapted system tools to get this knowledge. For market-driven projects, then, the aim was to have an approach that properly defined and presented the "primal facts" in that context.[27]

This conviction, though, no matter how correct, confronted a firm, longstanding boundary within Motorola that separated government from commercial work, for the reasons already outlined. They operated as two distinct worlds, seldom connected through personnel, projects, or flows of knowledge. In part, this separation derived from the rules of federal procurement and the fact that the Government Electronics Division performed security-classified work, with its attendant strictures. The division produced a steady, secure (through the better part of the Cold War) flow of income that leavened, in a small way, the vicissitudes of the company's commercial activities. This set of factors created an organizational view that government and commercial activities were crudely symbiotic in terms of the corporate balance sheet, but culturally, practically, and geographically unconnected.[28] Prior to the mid- to late 1980s, division management, located near Phoenix, Arizona, seldom and only incidentally was invited to Motorola corporate headquarters in Schaumburg, Illinois.

An opportunity to rethink this institutional boundary came roughly in the same period as Bertiger's reflections. In the mid-1980s, a Motorola commercial group that provided technical infrastructure for terrestrial cellular systems had a contract with Craig McCaw, a pioneer in cellular telephony. After the FCC authorized in the early 1980s the sale of licenses to provide cellular in US cities, McCaw looked to acquire a significant share of the new market, including establishing service in the Washington, DC, area. Motorola's commercial engineers, though, could not get the complex of components and software to mesh and function effectively—in short, they were entangled in a systems problem. Failure to perform here could damage Motorola's standing as a leader in the burgeoning field of cellular communications. Motorola management called in the Government Electronics Division to troubleshoot. In a period of months, their expertise rescued this vital contract. For Bertiger and other engineers in the division, and for Motorola leadership, it demonstrated that Cold War–developed methods and practices were indeed assets that could be made productive in a market-driven context.[29] By the end of the 1980s, the question was how or to what extent this nascent interface between corporate government and commercial work might be exploited.

For the Government Electronics Division, the question became more precise,

asking in what specific ways systems thinking might be conjoined with the transformations taking place in commercial manufacturing, at Motorola and at other firms. As noted, this did not merely involve adopting period enthusiasms for the market and capitalism's geopolitical ascendance, but also integrating Cold War methodology with the reigning responses by many manufacturing corporations to globalization: a preoccupation with process, quality, organizational culture, and the constellation of knowledge practices that became attached to these concepts. The critical mechanism for establishing this alignment from the Cold War to period globalization for engineers in the Iridium project was, as mentioned previously, Motorola University. It, and its precursors concerned with employee training within Motorola, constituted the primary corporate response to the challenges of global markets, serving as the node that reoriented the company's organizational culture and workplace practices. The university stands as the crucial background linking Iridium, Motorola, globalization, and engineering practice.

Motorola University

In 1979, in his essay *The Postmodern Condition: A Report on Knowledge*, Jean-François Lyotard made the central claim that the West had moved from valuing autonomous knowledge to, in his words, valuing performative knowledge—knowledge directed at the purposes of the social system within which it was generated.[30] His account is vague on the historical source of this transition, but by the early 1980s others were not—it was the ascendance of corporate values and neoliberal ideology in which the market, rather than modernist conceptions of knowledge as a self-justifying good, provided the primary framework of knowledge production. There is now a broad base of scholarship on the post-1980 reconfiguration of universities as this value system extended into the academy.[31] Rather less studied—at least from a historical perspective—is a concomitant and intimately related phenomenon: an energization of corporate interest in the issue of knowledge production and dissemination *in* the corporation, not just, say, in corporate labs but for the organization as a totality.

Beginning in the 1980s, and amplifying in the 1990s, there was what one might call a corporate university movement—a burgeoning of interest in creating an entity within the corporation that took the name "university." In 1985, there were about 200 of these; in 1990, about 400; and by the year 2000, about 2,000 such creatures, most in the United States, but with some in Europe and elsewhere.[32] As a crude comparison, in 2000 there were about 2,200 traditional 4-year US colleges and universities. This development was grounded in the per-

ceived challenges of globalization and in the corporate view that traditional universities, still primarily organized around mid-twentieth-century disciplines, were not equipped to deal with those challenges. Corporate-specific mechanisms were needed to deal with knowledge production and dissemination in a complex enterprise that sprawled over continents and confronted ever-changing conditions, with a workforce that reflected those geographical facts. It was to recognize that the corporation, and its relations in the world, was a distinctive domain of knowledge production and practices. Motorola University was created in 1989, one month after corporate leadership decided to proceed with the Iridium venture and a month after the fall of the Berlin Wall.

The university evolved from the Motorola Training and Educational Center (MTEC), established in 1981, primarily as a response to competition from Japanese firms. The creation of the university derived from an assessment, through the 1980s, that globalization required a broader, more thorough corporate response that intimately connected strategic goals, relevant knowledge, and employee behaviors. The university took shape through its president, William Wiggenhorn. He had come to Motorola in 1981 to head MTEC and through the 1980s organized the company's training efforts, building on similar work he previously did at Xerox. Indeed, when he initially was hired Motorola already was giving consideration to creating a "stand-alone" university, nearly hiring a university president rather than him to undertake this task.[33] So by the time of Motorola University's founding some version of a corporate-centric university had been "in the air" for nearly a decade. Wiggenhorn sought to give the new entity coherence by using the City University of New York as a model. As that institution defined its mission in meeting the needs of city residents, so Wiggenhorn thought his organization should meet the needs of its residents: employees at all levels of the corporation, who needed to be equipped to deal with the challenges of globalization.[34] Motorola University soon ramped up to a full-time staff of about 500, supplemented by several hundred more rotating appointments from within the company and from universities. The budget climbed to more than $120 million per annum; it was governed by a board composed of Motorola top executives. There were 12 physical campuses, 3 in the United States and the rest overseas, typically located near company manufacturing facilities, with the important exception of a campus in Beijing, where Motorola did not have a manufacturing facility. In Singapore, government officials were so enamored of the possibilities of Motorola University that they provided the funding for a physical campus and faculty with the specific purpose of adapting curriculum to meet the needs of the

"Asian learner." In addition to such facilities, the University had more than 80 "offices," small outposts that could reach the extremities of the Motorola corpus.[35] Within this framework Wiggenhorn saw culture as a critical element of the enterprise, especially to train "managers who have been very successful in their own culture to learn to lead in different cultures, rather than taking what I call the colonial master model from the East Coast or Midwest and putting it in India or China."[36] But the fundamental aim of the university was to develop and give form to domains of knowledge immediately relevant to the corporation. One can get a sense of what this was all about from the university's department structure: Quality, Engineering, Manufacturing, Leadership, Management, Sales / Marketing. Each department developed its own curricula (a defining aspect of Wiggenhorn's approach). But that process did not rely on an instructor's expertise, but came from an analysis of working-level knowledge needs: "We put together teams of internal Motorola people managed by our [MU] staff, three hundred some, who studied what it is you need to know in manufacturing based upon where manufacturing was going to, from a quality point of view, cycle-time point of view, automation point of view."[37] For example, the courses for quality focused on three areas: quality as a concept; training in a variety of analytic techniques such as Pareto charts, Ishikawa diagrams, and other methods (the bulk of the course); and then a practicum applying what was learned to a business situation. Covering the major functional areas of the corporation, the curriculum then was reviewed by "councils" of experts, with the charge to evaluate whether "this is what your people need to know."

In this way, course content was meant to directly translate into an employee's work situation, that is, to be performative. In turn, this was the means for the university to be performative, that "whatever we did was trying to impact positively the profit and loss of the company."[38] The course catalog included about 1,000 offerings. Each Motorola employee had to take a week's worth of training per year, a nontrivial exercise for a company of more than 100,000 employees, placed in the United States or at company sites around the world. But the training was not one-size-fits-all.

The various overseas campuses could develop curricula that fit local circumstances—say, in Penang, Malaysia, where the majority of employees were Muslim women.[39] Wiggenhorn's faculty discovered that "we couldn't teach as we did in the US . . . to put them in classrooms and say 'do this.' We had to teach them that when they were in our manufacturing plants or semiconductor plants in Malaysia that they were in quote 'Western theater.' We are not asking you *not* to be a

Muslim lady. We are just saying when you are in these walls, you're in Western theater called semiconductor, and here's what we want you to do, here's how we want you to behave. When you walk out of this theater at night, you are a Malay Muslim lady."[40] Thus, though, manufacturing was ostensibly about "quality" or "cycle time" it also was a mode of life, imbued with ethical distinctions between "in here" and "out there," a question of negotiating the boundaries of identity and individuality. As is obvious from this example, such distinctions were made more evident in cultural settings radically different than those in the United States. In different ways, such positioning of the "in here" in relation to local cultures also occurred in China as well as Europe. Such difference between global multinational and local contexts readily raised questions of ethics—of the basis on which such engagements would be given a specific form and meaning for the individuals involved, as in the Malay case. The problem of ethics would return in a project later in the 1990s through the preparation of a Motorola University handbook called *Uncompromising Integrity: Motorola's Global Challenge*, which will be discussed in detail in chapter 4.

Motorola University did not represent a turn inward as regards knowledge production and dissemination, but the opposite: it aimed to more tightly integrate the corporation's internal and external knowledge activities. In the case of academia, the university's charge was to increase and deepen such relationships. In the United States, the company had ongoing collaborative relationships with about 20 universities, including prominent Midwest institutions such as Purdue and Northwestern. Equally important were Motorola University's connections with universities abroad, especially in China, where it entered into a series of collaborations with Chinese institutions to create certificate programs in how to educate in the US manner. It also entered into collaboration with Arizona State University to offer a joint MBA to students in China. In a classic strategy of integrating backward and forward, the university also trained suppliers to Motorola to inculcate in them the Motorola ways of doing. In complementary fashion, the university also trained government regulators in emerging economies, particularly Russia and China, on to how create regulatory policy for communications—of special significance for Motorola and its product lines. Motorola University devoted six years to this effort in China, beginning in 1990. This latter work especially benefited from the "university" moniker—taking guidance from Motorola University, rather than Motorola the company, seemed to offer a kind of neutrality.[41]

Motorola University's intellectual orientation around "process" and "quality"

found synergy, not surprisingly, with the Clinton administration's promotion of "reinventing government," an initiative led by Vice President Al Gore. In 1993, as a key example of this initiative, Hazel O'Leary, Secretary of the Department of Energy (DOE), brought a contingent of "sixty of the Department's top executives, including laboratory directors, field managers, and key program managers" for six days of training at the university's Schaumburg campus. Its purpose was to reorient DOE leadership to the perspectives of total quality management: "to begin building a management cadre dedicated to meeting customer expectations by providing quality products and services."[42] This exercise exemplified the perception that corporations such as Motorola were at the vanguard of addressing the knowledge and organizational conditions posed by period globalization. But the scope of the DOE and university collaboration reached more broadly. Motorola University entered into agreements with Los Alamos and Sandia Laboratories to exchange staff; university instructors did training work at the laboratories and laboratory staff did instruction at the university. But, as described by Wiggenhorn, the focus shifted from "quality" and its value in the present to "what does the future look like, how do you transfer know-how [among institutions]."[43] The unstated context was that of globalization and its new requirements for particular types of knowledge and knowledge flows.

Motorola University thus followed the global emplacements of Motorola the company, with knowledge activities calibrated to variations in business conditions and roles across the firm—at the level of headquarters, managers, and a variety of levels of employees; in specific business units; in specific geographical and cultural settings. It dealt with flows across the organization and nurtured numerous contacts at the boundaries of the company. The sheer scale of this effort, in terms of geographic reach, of the range of actors it included, and of the knowledge domains it sought to embrace, suggests the degree to which ways of doing, from the manufacturing floor to leadership and strategy, had become a corporate preoccupation. The university certainly was a vehicle for extending the reach of corporate control in the classic sense (such as in co-opting state regulators), but more broadly, it was site and symbol for giving substance to the idea of "quality" and its implementations, bringing it into the mental framework of each employee. Such effort was oriented toward creating flexible routines and new ways of doing (including in the area of ethics), modifying existing practices, and, especially, bringing areas of corporate life (such as general administration and planning), previously relatively unscrutinized, into the framework of analysis. It was fundamentally about the value of procedure and routine, but attitudinally

and epistemologically it put such concerns in a new frame both as objects of ongoing critical attention and recalibration, and as relational problems tied to the complexities of the corporation as global actor. And, in such framing, the agency of individuals (in theory) was the essential element—the very reason for belief in the efficacy of a corporate university.

The media enthusiasm for the narratives of invention, entrepreneurship, and global-market churnings (particularly in the realms of communications and computing) gave preference to an Iridium origins story that favored serendipity and the motive power of a world ordered around private capital. A nuanced account, though, lies behind this story, connecting engineering practice, the Cold War, and the changing environment of the mid-1980s, within corporations such as Motorola and across the international landscape. Old boundaries were being reconfigured as the idea of the global and markets gained ascendancy. This helps us understand how by 1989 an idea for a grand technology project, privately financed, seemed credible and how a group of military engineers, sitting in Arizona, traditionally isolated from the power center of their company, could find common cause and support with Motorola leadership, becoming an emblem of a forward-leaning faith in markets and the global as a way of life.

The Iridium Idea and Engineering Design: Notions of the Global

In the period immediately after the Iridium concept was considered by its inventors and the Systems Engineering Group, they conceived the military as the natural customer for the project. The group had invested energy in convincing the DoD that it could perform as a prime. In informal planning discussions in the late 1980s, military officials had expressed interest in developing a communications system that provided coverage in "remote areas"—an indirect way of highlighting military interest in fully global communication capabilities.[44] A space-based cellular system thus fit the group's strategic vision and seemed to meet a military need. Motorola pitched the idea, but given the context of declining Cold War defense budgets, it seems both Motorola and the military reevaluated this possibility, envisioning future collaboration but not as partners in development.[45]

Under Durrell Hillis's leadership, the group, in the 1987–1989 period, began to frame the project explicitly as a commercial undertaking, deepening their articulation of technical details and, in this planning context, their relation to costs, modes of financing, and longer-term market goals for the group and Motorola.[46] The birth and early development of a proposed system for cellular global communications thus was tightly bound to the end-of-Cold-War government-market shift, as

experienced through the specific circumstances of a military contractor embedded in an iconic Fortune 500 commercial firm. Through the 1990s, this interplay between military and commercial cultures within Motorola, and between military and market interests in the larger world, remained, revealing the multiple threads that composed the period's notion of the global.

Yet in a major corporation such as Motorola, the ideal of nimbleness and encouraging new ideas—especially one of this magnitude—competed with the realities of working through large and multiple bureaucracies. To push a big idea of a planet-embracing space-based cellular system was de facto problematic. The three inventors and the small Systems Engineering Group in which they worked embarked on a concerted process of refining their concept, critical reviews, meetings, and promotion, pushing the proposed venture through the company vetting process—a challenge amplified by the scale of the idea and the novelty of a major commercial venture issuing from the company's government contract unit.

The process involved methodically taking the broad concept and deepening the technical details, layer by layer. Recall figure 2.1, the crude sketch and summary of the Iridium idea. That 1988 "back of the envelope" concept would, through the ensuing years, evolve, in steps, to an increasingly rich catalog of specifications and technical relationships—a task, though, that was dependent on the number of engineers working on the project and the resources at their disposal. But before such refinement could occur core technical choices not specified by the original concept needed to be explored and assessed. How many satellites in what orbits? What cellular patterns, with what signal strength, should be projected onto the Earth? What kind of antennas, in space and in hand receivers on the ground, would make the system effective? Even the foundational notion of a space-based system was reconsidered and the possibility of an upper atmosphere network of balloons evaluated.[47] But one key aspect of the original idea was not reexamined: that the system should be totally global in scope.

All this work was being done with modest resources. In late 1989, when Motorola leadership approved and committed several million dollars to the project, staffing was at roughly 10 personnel; in the next several months that number increased to 30 or 40, with many staff sharing the use of personal computers and cellular phones.[48] In early 1990, nearly three years after the initial concept, the technical details still were at a rudimentary state, but with corporate leadership ready to commit more than $175 million to turn the concept into a business.[49] As the engineer Raymond Leopold recalled: "I wrote the first two A Specs, as we called them, the system-level specifications for the system. The first one was

March of 1990, the second one was June of 1990, and it basically described at a very top-level form the specifications for the system that you flow down [to more detailed specifications]. My original A Spec had thirty or forty pages. The final one we had [circa 1995] that we built the system on had close to a thousand. That just fed into reams and reams of lower-level documents."[50] The "flowing down" was to subsystems and then individual components and sometimes subcomponents.

Once the fundamental technical assumptions and choices had been clarified, the deepening of system level details proceeded. These included the size of the satellite, the strength of signals required for effective communications, the total number of satellites, how they might be arranged in Earth orbit, and how to undertake the "crosslink" communications among adjacent satellites, a crucial feature of the big concept. The staff also had to integrate into this planning the launchers used to place the satellites in space, especially as to assessing how the characteristics of different launchers affected spacecraft design. For the Earth-based elements, they needed to model what capabilities users might expect in the system and in what ways the space-based capability might integrate with existing ground telephony, either landline or cellular (the result of which was the capabilities sketched in fig. 2.3). By late 1989, these assessments had arrived at a relatively settled design—77 satellites, arranged as 11 satellites in 7 orbital planes, with near-equidistant spacing, each tracking over the Earth's poles. This atomic-looking structure (fig. 2.2) provided the basis for naming the project "Iridium."

And, prominently, of course, the staff needed to correlate this evolving technical detail and design activity with cost—specifically and most important, a fixed cost—and with time. Given the vast expense of the project (which a fixed-cost model was meant to constrain), design and manufacture time had to be collapsed as much as possible to enable the possibility of a return on investment. Expressed this way, cost and time seem obvious but somewhat abstract—the question was how to materialize them in organization and in work practices. It was the commitment to these abstractions that elevated process and quality—those defining but somewhat vague attributes of 1980s global commercial culture—as critical elements of the project. The elaboration of technical details, then, did not occur as merely a sorting through of the puzzle posed by the original concept but as intimately bound to those allied concepts through which cost and time became concrete. The notions of process and quality thus provided the assumptions and the methodologies that shaped choices and negotiations among engineers and,

concomitantly, gave the project a particular cultural cast. In the project, the guiding mantras of process and quality would coalesce into a design criterion called "manufacturability," which, as the term suggests, took as a fundamental concern whether or not a design could be executed efficiently and with a minimum of mistakes when confronted with the realities of life on the factory floor, which included prominently the need to integrate systems and components that came from multiple institutions (the very idea of the virtual factory).

These related aspects of the engineering effort, technical and methodological, had a dual purpose. One was to enhance Motorola's own confidence in the plausibility of the project, as reflected in the 1989 review and approval by top management. The other was to convince critical external audiences—investors, foremost, and the two regulatory entities that held authority over communications and radio spectrum issues, the FCC and the ITU, of the project's merit and plausibility. Thus, the process of analyzing and elaborating technical specifications of the system, and of the methods that would enable its completion, intersected with these external concerns. In June 1990, as noted in chapter 1, Motorola announced the venture, with publicity events in New York City, Beijing, Melbourne, and London. Later that fall they filed a request for spectrum at the FCC. In late 1991, they sought investors through a Private Placement Memorandum (PPM), followed in early 1992 by regulatory approval before the ITU's World Administrative Radio Conference (WARC). Each of these steps required a coherent statement of the technology and system and how they integrated into a plausible plan for a business.[51]

But in pitching Iridium as a global venture—one seeking to readjust national and global regulatory regimes—a crucial question arose: who were the intended users of the system, the very basis for providing business and regulatory justification for a multibillion-dollar planetary communications network? As Iridium rolled out the project, especially in its media announcements, the answer to this question was unclear. Corporate messaging tended to pitch the system as a general utility potentially providing benefit to everyone, especially those in areas with minimal or no communications infrastructure.[52] As a design matter, though, the system needed a core assumption as to its defining use and market. Perhaps not surprisingly it focused on a very particular class of users that by the end of the Cold War had become emblematic of the processes of globalization: international business and other well-heeled travelers, primarily on the move from developed to developing nations, from West to East and South. At Iridium's inception, with the communist world collapsed, this phenomenon seemed likely only

to expand and intensify. The limited nature of both terrestrial and cellular service at this moment in time seemed to give added justification for a global system to serve this elite market. Iridium thus aimed to build on the then existing modes of the global and reinforce them through its own amplified expression of what the global might become with more comprehensively available communications.

Such reasoning reflected the experience of Motorola officials in their travels internationally, a view that in 1991 gained additional credence through a first-blush marketing study.[53] But for engineering purposes a further assumption was required: how would such travelers actually use an Iridium phone? The answer was that the system would have to enable a specific and not immediately obvious use: a voice transmission from an automobile as a caller traveled from an international airport to its adjacent city (most such airports were sited outside major metropolitan areas). The goal was to enable the international, well-heeled traveler to call back to the home office or another site to coordinate global business among relevant associates. The entire technical specification of the Iridium system was designed to meet this scenario. The crucial design element was creating sufficient "link margin"—radio signals with enough power—to meet this specific, perceived service expectation of the system's primary users.[54] Determining this link margin then determined every other facet of the system—the numbers of satellites, their size, their power, their antenna design, all grounded in a particular construction of how global business practice operated and would operate in the future.[55]

But as the project developed in its very first years, there was a critical miscommunication in the engineering team as to the specifics of the business-traveler-at-the-airport scenario. Hillis had assumed it meant the Iridium phone could be used by a business traveler inside the car; his engineers thought it meant the satellite system only needed to communicate effectively with an antenna attached to the car.

The two versions had different implications for the link margin provided by the constellation. Awareness of this difference in perspective occurred at a critical time—in February 1992, as Motorola and Iridium were presenting their plan to WARC, an occasional international plenary organized under the auspices of the UN's ITU that adjudicated changes in and claims to the world's radio space. Iridium, as well as several other firms competing to provide space-based cellular telephony, was there to gain approval from the world community to proceed with its effort (see chapter 3 for the political aspects of this story). Without such approval, the venture could not proceed. Iridium had come to the meeting with a system based on a constellation of 77 satellites with a certain link margin (based

on the scenario of an antenna attached to a car), but realized, after new simulations done by the engineering team now aware of Hillis's expectations, that the entire system needed to be redesigned to provide a heftier link margin. During the months leading up to WARC, Hillis noted that he

> was traveling most of that time, so I had not reviewed the thing [the system specifications] in detail for probably three months or something. And I had discovered, during WARC, that there was a miscommunication between me and the team. When you get to the airport, classically, you go rent a car or you have a driver, or whatever, if you're an executive. First thing you do when you get in the car is you take your cell phone out, and start talking to your office. Well, now you see people doing it walking down the airport corridors, but at that point, that wasn't typical, because the cell phones were bigger, and you kept it in your briefcase, not in your pocket. So you get into a taxi, a rental car, car driver, and you get out your cell phone and you communicate. And this was a guideline that I established, because if we've got to pick one, based upon my travel, I'd say our target is the international traveler, the executive, the government official, the high end. That's how we use it. So the guideline has to be, he's got to be able to get into a car with an Iridium phone, from a typical international airport, and go from there to downtown and communicate effectively, inside the car.[56]

The recollection captures the pell-mell, frantic nature of the project. But even more it highlights the way in which engineering sophistication (although caught in a key error) sat side by side with an essentially anecdotal idea as to the social reality into which satellite phone service would fit. This juxtaposition of rigor with casualness indicated the sway engineering worldviews had on the effort, especially as to their sufficiency to initiate the project through a series of high-stakes financial and regulatory passages. But the reverse was true, too: to conceptualize the system as system the effort needed a core narrative of use, of social behavior and expectation. Failure to design the system to Hillis's imagined scenario had significant consequences for the project:

> What I discovered when I was at WARC, I was talking to someone and I discovered that the guys were doing all the design, assuming you had an external antenna on the car. I said, "Oh, no, no, no, no." So I left WARC, I go back to Phoenix. The system was redesigned in two months. That's when we went from seventy-seven, the original Iridium, to sixty-six.

As a matter of consumer behavior, Hillis reasoned:

> Because what we had to do was build bigger satellites in order to have bigger antennae and more power, to make the link margin requirements to get inside the car. So that's when we went from seventy-seven to sixty-six. Oh, it was a critical question, right? Because we said, "You can't expect the user to say, 'Oh, excuse me, driver, can you wait while I put an antenna on top of the car?'" [The revision of the constellation to 66 satellites] . . . was an economic tradeoff. In order to get the link margin, you had to build the satellites bigger. Now, you've got to find a way to make the system cheaper, because we've committed to a system price.[57]

Though Hillis's anecdotal scenario of use served an engineering purpose, would the resulting design actually do what users wanted? A 1994 focus group study found potential users were excited by the "notion of a universal communication device" and "envisioned that tens to hundreds of people in their organization" would want such a service. But once the focus group knew more about Iridium's communications capabilities, they were less enthused. They did "most of their communications in and around buildings" and wanted to overcome "problems in major foreign cities, seldom focusing upon needs in remote areas." But even when in remote places "these areas often had dense foliage and/or there were hotels nearby . . . the group characterized the product as suitable only for oil rigs or the desert."[58] This study and others captured this tension among the designers' narratives of use, the need to make engineering commitments, and the actual expectations of consumer toward a system not yet built.

At WARC, Motorola and Iridium worried that the need to redesign substantially the entire system might cause the conference to not consider their request for approval—a potentially devastating blow to the venture, whose ambitions already had been widely covered in the media. As Hillis noted, his engineers needed to do a series of tests and simulations to ratify a new design that provided the power to penetrate to the interior of an automobile.[59] In the initial version, the satellite buses were hexagonal and the antennas integrated into the surface of the spacecraft. To generate signals of sufficient power the satellites were made larger, reconfigured to a triangular shape, and antenna panels, larger than the original design, were appended to the spacecraft. To keep the project at the same cost, the constellation was reduced in size, from 77 to 66, in a revised arrangement of 6 orbital planes, each with 11 satellites.

The trajectory of the design process will be further discussed, but the system

and spacecraft configuration reflected Motorola's sense of the global and of global travelers in other ways. In addition to the antennas used to communicate with Earth-based cellular phones, each satellite also had "crosslink" antennas, used to communicate with satellites directly in front of or behind a given satellite in an orbital plane or with satellites in adjacent orbital planes. These antennas were integral to a distinguishing technical feature: on-board switching of communications signals—that is, routing of calls through the space system to a specified destination. Iridium thus could process calls in two ways: from one Iridium phone to another anywhere on the planet through the constellation (as a "stand-alone" communications network), or by connecting an Iridium phone call to land-based (line or cellular) systems through a ground station that linked space- and land-based networks (see fig. 2.4). On-board switching, then, was an essential technical expression of Iridium's conception of the global, allowing the system to operate over the totality of the planet.

Though switching was a common element of land-based telephony, it had not been used in commercial communications satellites. These satellites traditionally had been "bent pipes"—they served as conduits positioned in geostationary orbit to relay communications from a given point on Earth to another point or region. To make communications satellites as reliable as possible they were designed as simply as possible—that meant no on-board switching capability. But NASA did test switching technology on its Advanced Communications Technology Satellite (ACTS), launched in 1993. ACTS was the last in a long-running series of NASA experimental spacecraft intended to assist the communications satellite industry in evaluating new technologies.[60] Significantly, Motorola received the contract to develop the switching technology for ACTS, an experience that directly influenced the company's decision to use the technology in Iridium. Thus, Iridium's use of switching technology followed Hillis's rule of thumb to prefer known rather than experimental technologies.[61] The choice to use on-board switching, too, encapsulated Hillis's strategic view that the distinctive frontier of communications satellite innovation was in the sophistication of a spacecraft's payload of electronics and in the related skills to link individual payloads into a complex system—the very import of the idea of switching among satellites. Switching expressed thus not only a technical view of the global, but a corporate strategy that innovations in the processing and movement of information spoke to the new global realities. Such framing put Motorola's own technical strengths at the center of the global—a view that justified its ambition to be a prime.

Significantly, Iridium's primary competitor in satellite telephony, Globalstar,

followed the traditional standard. Satellites in its constellation acted as "bent pipes," a design choice that required tens of ground stations to deliver coverage, each of which provided the switching that Iridium performed in orbit. And given the expense of ground stations, Globalstar targeted its service to the most populous land areas, bypassing coverage over less-populated higher latitudes and over the oceans. Globalstar's design and business choices highlighted Motorola's distinctive, more comprehensive conception of the global, one that embraced commercial and military activity over the entire planet.

But the ambition reflected in the Iridium system's design was balanced against the realities of the political landscape in the post–Cold War world. The constellation's on-board switching capability meant that processing calls through the system technically required only one ground station to link the network to land-based networks. Over most of the twentieth century, though, most countries controlled communications, either directly through state-run entities or through designated corporate monopolies (as with AT&T in the United States). Iridium (or any communications venture) needed permission to send signals in and out of any national territory. For a global service this meant the negotiation and arrangement of permissions on an unprecedented scale. Even with the move in the 1980s toward privatization of communications, states carefully examined granting control over communications within their territories to foreign firms. Thus, as a matter of politics, Motorola and Iridium courted companies and state entities from nations around the world to participate—as investors to spread the financial risk of the project and as owners of gateways. The gateways served as inducements to support the venture. They acted both as technical entities that linked the constellation to ground-based communications and as business units that sold Iridium service in a particular region. In China, for example, such an arrangement was crucial to gain access to this market. The inclusion of "not technically required" gateways greatly complicated the production of software to operate the system as well as the business structure of Iridium, contributing to the venture's eventual bankruptcy.

Gearing Up the Engineering Effort: Merging the Cold War and the Market

By 1990, the global business traveler—and thus the concept of a market-centered world—had become the venture's organizing presumption, the kernel from which the system took shape. The post–Cold War military as user, particu-

larly that of the United States, with its global, everywhere interests and activities, integrated smoothly into this framework. In part, this was a result of a post–Cold War shift in DoD policy in the area of communications to give increased preference to purchase services from the market rather build its own separate systems.[62] But the conjunction of military and market practices extended also, and especially, to the engineering aspects of the project. Consider the key questions confronted by Hillis and his colleagues: Who would build it? What financial understandings would structure the work? What concepts, practices, and organizational tools would carry the project to conclusion? Given the context of the project—its institutional placement at Motorola in a government unit embedded in a larger corporate commercial culture and its historical timing at the end of the Cold War—the answers to these questions would be a hybridization, as outlined previously, of Cold War and market ways of doing. A vital source of technical talent resided in Cold War firms, with their cadre of personnel adept at a particular historical tradition of implementing state-sponsored large projects. But the political economic conditions for applying such a skill set had changed. The funder was not the national security state, often tolerant of cost overruns and schedule delays as the price of achieving technical advances and working systems; it was commercial investors, the market: Motorola, the company in full, not just the government services unit, other corporate and state equity investors, and, later in the mid-1990s, commercial banks and stock investors. In this political economic reality, adhering to cost and schedule mattered. In this context, then, commercial conceptions of design, production, and organization had to be interwoven with the heritage of Cold War structures and methods—or perhaps to use a metaphor, commercial DNA and Cold War DNA had to be combined, creating a hybrid. The question was, from 1990 through 1998, when the system went "live," what that hybrid might look like, what tensions it embodied, and how it related to the broadening and amplifying condition of the global in the 1990s.

These circumstances primarily will be examined through the perspectives of several who occupied key positions in the engineering effort. Durrell Hillis, as manager of the Government Electronics Division and of the Iridium project, provided the broad perspective involved in transforming a government-contract shop into an important subset of Motorola's large commercial portfolio. It was his task to negotiate this transformation—to recalibrate the boundary between the government unit and Motorola and create the working outline within the Iridium project on how to relate Cold War legacies with commercial concepts. Within

the Iridium organization itself, the tensions and differences between commercial and Cold War methods took a particular form. By 1990, Hillis had appointed Dannie Stamp, who had just completed two decades of managing weapons projects in the US Air Force, to head up what was called Satellite Systems Engineering, the entity responsible for developing the satellite constellation, including relations with contractors, integrating and testing satellites, handling launch activities, and checkout of spacecraft once in orbit.[63] In short, he had a role analogous to a major program director in the military. But Hillis also hired, at this early stage, a director of manufacturing, David Montanaro, who came from Apple and was charged with bringing contemporary manufacturing methodology—with its emphasis on process as the guiding precept—into the project. Though there was no formal connection between Montanaro's position and Motorola University, each placed high value on commercial process methodologies.[64]

Despite the seeming overlapping responsibility these position titles suggested, Hillis established an important distinction between the two men's roles: Stamp was vested with line authority over the entirety of activities required to build and launch the system; Montanaro filled a staff function. His role was advisory, to be a kind of gadfly, an ongoing voice of commentary and assistance to Stamp's line responsibility for producing the entire system. Though not all of its role, a critical charge of Montanaro's group was persuasion: "we were trying to set up a framework . . . a set of, especially marketing and rhetoric and materials, that we could go out, we could get people to transform people's behavior, basically making them reluctantly compliant." This point highlighted the work required to implement thoroughly a process-oriented view of work as well as the centrality of individual acceptance or reluctance of one's role in the culture of the project. This early decision on the project's organization fundamentally shaped the effort during the ensuing eight years.[65] As the project grew from concept to production, the number of personnel grew from tens to hundreds to thousands, and in the difference between line and staff activity in a project, between Stamp's and Montanaro's respective roles, the bulk of that personnel reported to Stamp. Montanaro's group never exceeded more than 10 people.

Though this arrangement suggested that Cold War methods, often emphasizing hierarchy and authority, predominated in the project, the balance between the two outlooks was more complicated. The concept of "process" was a conceptual touchstone at this historical moment—intimately linked to the broader context of globalization and Motorola's response to it in the 1980s. Though Stamp came from the world of military program management, he quickly re-

oriented to the new context, capturing the tension between old and new methodologies and the status of the individual therein: "I took Motorola's Design for Manufacturability courses; I took the Motorola Six Sigma Design for Quality courses; I went up to Motorola University in Chicago to train myself to have some commercial manufacturing expertise, because all my background was government manufacturing. As a matter of fact, I took it twice, because my worst fear in running this was that I would lapse to my old government ways. So my worst fear in running the space side was that I would regress to my old government manufacturing ways, so I actually went through several of the courses twice."[66] But this preoccupation with adapting to the world of the market was not just about recasting and streamlining processes of all kinds as a means to meet the project's cost and schedule targets. It also embraced a reorientation of the political and cultural economy of the corporation. These were inseparable enterprises.

This can be seen along several angles. During 1990–1992, as Motorola engineers worked to take the broad technical concept of the satellite and deepen the technical specifications, Hillis began to seek out industrial partners, those Cold War firms already adept in satellite design and manufacture. He had an advantage. With the decline in government procurement dollars, these firms were looking for business. But Hillis insisted that any partners commit to a commercial political economy: to work on the project without compensation until Motorola raised equity capital; to accept and genuinely implement commercial methodologies; and to agree to a fixed-price contract (which meant genuinely understanding their own capabilities and costs before undertaking work).

Hillis also insisted on two criteria common in government work: that companies assign their best staff to the project and that their corporate management see the project as of strategic importance. In terms of design, the satellite system readily separated out into three major subsystems: the satellite spacecraft bus, the main mission antennas (used for communicating between the constellation and Earth-based phones), and the communications payload. Motorola would produce the latter—the technology that gave Iridium its distinctive capabilities—and provide overall system design and integrate all the subsystems into a finished whole. These reflected the company's twin, related goals of being a prime and, of course, exercising technical and financial control of the project. The major elements to be contracted out were the spacecraft bus (the satellite structure and basic operational technologies such as batteries and propulsion) and the antennas.

Hillis's pursuit of a supplier for the bus exemplified the changed character of organizational and financial aspects of commercial work. He noted that

> there was one company at the time who was a very strong contender, along with Lockheed and Boeing, and at the time it was Martin [Marietta]. And we went around to these suppliers and had—this is another thing we did that I think was kind of unique. We had a team of us that went around to the suppliers, and we told them—the potentials, the want-to-be suppliers—"When we come, we want you to present your team that's going to be on the program, and we want our technical, the technical team, primarily, we want our technical people to be able to interview every single one of these people, to determine if we're getting the first team or not. We want you to tell us about your initiatives and cycle time and quality and so forth."[67]

The latter, of course, were markers of the language and practices of commercially driven manufacturers who had lived through the economic pressures of globalization in the 1980s, but that were not yet common in the organizational cultures of aerospace firms. They signaled, too, that in Iridium the subcontractors were subsumed in the virtual factory, part of the larger problematic of redefining what manufacturing meant. Hillis's way of probing the cultural boundary such language and commitments implied was

> to meet with the manager that was at least two levels above the people we were meeting with, and the purpose of that was for me to try to look into their eyes and try to see if I could tell whether they thought this [way of project execution] was strategic or not. We had one gentleman . . . I had this talk with him, and he looks me in the eye, and he asked what I think is a fairly sensible question, but it was the wrong question. He said, "Why should I do this?" You know, it's not that bad a question, except what it told me was that if he doesn't know why he'd do this, I don't want this company to have this big a role in the program, because either he's got to see it or not.[68]

In the larger context, such questioning highlighted the issue of where the aerospace industry saw its future economic opportunities. The decades-long legacy of government work, and its profitability, even with the waning of Cold War budgets and contracts, did not necessarily make commercial work either attractive or imperative. How to integrate government and commercial skill sets *for the market* had bedeviled the industry since the late 1960s—and continued to do so even as market talk and possibilities ascended as the perceived dominant motif of the

future. Seeing the possibilities of the market world required an element of faith. Hillis found this at Lockheed:

> By contrast, Dan Tellep, who was the CEO of Lockheed, I met with him, and he saw this as being strategically important to Lockheed, because Lockheed felt that they needed to expand in the commercial world. . . . So he basically assigned the effort to what turned out to be his most senior division manager at that point, Vance Coffman, who is now [2003] the CEO of Lockheed-Martin . . . they viewed this with great strategic importance, Dan Tellep himself, and that was a major factor in Lockheed getting the program.[69]

Potential suppliers, beginning in 1990, even before being awarded a contract had to work at Motorola, in Chandler, Arizona, to participate in deepening the engineering analysis as the effort continued to seek funding. As engineering partners they also had to *learn* commercial manufacture, not just accept it in the abstract:

> We also were very, very hard over on what we called the initiatives; that is, cycle time and quality, because we knew we'd never get through that program with the typical way people did business, particularly in the government space world. . . . We actually sent our contractors to Motorola University, to be schooled on our quality program and our cycle-time programs. But we had to qualify them, in terms of where are they, what's their attitude about it, are they committed to it, are they doing anything in it.[70]

Not least, Lockheed and Raytheon had to pay for the privilege of joining the effort, a practice at variance with Cold War approaches:

> So the other thing that was sort of a weed-out factor, to determine whether this was strategic to people, we said, "Look, if you're the one who is the major, the bus supplier, for example (and in the case of Raytheon, the major antenna suppliers), you're going to have to have people on site in our facility, working as a design team. And I don't know for how long, and we don't pay you a nickel. It's all at risk. So either you believe in it or you don't." And so they [Lockheed and Raytheon] did. They signed up people on site for two years.[71]

The key element to accept for each was the risk of a commercial venture—a field of risks different from that associated with the realm of government contract. And, of course, so was the potential for reward, assuming the cost-quality-cycle time mantra of commercial manufacture produced development savings on

the front end and market success on the back end. Both Lockheed and Raytheon spent about $20 million supporting this early phase of the project and then became minor equity investors to cement their commitment to the venture.

In mid-1993, Motorola and Iridium acquired the first round of investor funding, $800 million. Soon after, the contracts with Lockheed and Raytheon were finalized, as was, and equally important, the contract between Motorola and its start-up, Iridium. The cascade of contracts went from Iridium to Motorola to the various suppliers, big and small. All these were interlocking elements: the technical effort, the quest for capital, the organizational relationships, and the push for regulatory approval through the FCC and WARC. The Motorola engineers—and by extension the larger engineering team—were essential on each front of the effort: their ability to demonstrate technical competency to various audiences built trust in the venture in the present and in projecting a few years ahead. Ray Leopold, one of the triumvirate of Iridium's inventors, outlined the steps in creating that engineering foundation that occurred concurrently with the organizational, financial, and regulatory vectors of the initiative:

> You have to understand that in parallel with all of these things, we were working harder and harder on the actual technical side. We were bringing people in, we were lining up other strategic partners, we were honing the design, and we were reworking the financials. We finally got enough of a team together, because we were less than ten people for the early days. Finally, in about April of 1990, we were up to about thirty or forty people, and three-quarters of them were technical people. So we were finally getting a little bit of a head of steam, and by the end of 1990 we were probably up to sixty or seventy people, where we were really able to do some real advanced engineering as opposed to just conceptual designs. We finally put together a big massive trade study [assessing the relation between engineering choices and respective costs] . . . just to test our design point.

In comparison to a typical defense project, this trade study made cost a central problem and fit it into a different political-economic matrix. It came after the public announcement of Iridium in June 1990 and after the filing of an application to the FCC requesting radio spectrum. The trade study, in essence, sought to confirm whether the engineering challenges of the project actually could be achieved at a cost that made sense in terms of a projected market for global telephony. Part of the ambience of the market world was to bootstrap the multiple

moving parts together. But engineering knowledge and its elaboration into ever-greater relevant detail was foundational:

> But this is when we went through the actual more detailed analysis of what exactly we're going to build, exactly what it's going to look like, exactly what kind of launch vehicles the satellites are going to fit in, exactly what things are going to cost. Because again, with the conceptual design, we had a conceptual design, we had costs against the conceptual design, we had schedules, but then you get into it and say, okay, you got this, now how do you hone the design? The real manifestation of this was this massive trade study that we did, tradeoff analysis, and it came together in late '91, just after we went out with this Private Placement Memorandum in September of '91 and into the early part of 1992.[72]

As noted above, the PPM was the critical means of explaining the project to and persuading potential equity investors to buy into the venture. The engineering case stood as a pillar of the document, answering the question "could this be done technologically, within an appropriate budget?" The completion of the trade study after the issuing of the PPM, and after other public representations of the project, highlighted not only Motorola's confidence but also the elevated role of time (in comparison to Cold War methodology) as a driver of both the engineering and the business dimensions of Iridium.

The trade study fed into subsequent refinements of the systems specifications, steps traditionally known in Cold War project management as Preliminary Design Review (PDR) and then, as last iteration, Critical Design Review (CDR). The latter provided an in-depth assessment, leading to the close detail for actually building the system.[73] But these Cold War practices, as Hillis's selection process for Iridium's major suppliers suggested, were a set of tools to be repurposed and adapted to the market necessities of keeping to schedule and within a specified budget. Those necessities, infused with 1980s and early 1990s preoccupations with process, culture, and the global, provided the incentive to reshape the meaning and methods of the Cold War project.

"Manufacturability": The Global, Process, and Culture in the Factory

Consider two images (fig. 2.5 and 2.6) of an Iridium satellite under assembly on the factory floor. Why does the spacecraft body (fig. 2.5) have two large apertures, each of which remained open to the space environment in orbit? A partial answer is straightforward: to allow workers ready, waist-high access to a satel-

Figure 2.5. This is the basic satellite bus structure. Note the two apertures, providing openings for workers to install interior components. The white circular structure is part of the moveable dolly on which the satellite bus rests; it could be rotated to facilitate installation of interior and exterior components. Note, too, the various station signs in the assembly factory, indicating the different, sequential steps of integrating the satellite as well as the testing regimen to verify its readiness for flight. Used with permission of Motorola Solutions, Inc.

lite's interior to affix and test the communications payload during manufacture and checkout. This design feature dovetailed with a careful reassessment of the behavior of spacecraft electronics in orbit. A review of data showed that an open design, supplemented by a thermal blanket to cover the electronics, was just as effective in maintaining and regulating the ambient temperature of the payload as a traditional enclosed design. Spacecraft performance was essentially the same in either approach. But why did such seemingly specific technical and design decisions have import? This and similar, numerous choices in Iridium signaled a broad rethinking of the traditions and procedures for building satellites to reflect the different imperatives of the market. Managing time and cost became an overriding consideration, putting a premium on reducing the number and type of steps in manufacture and integration—to make process a foundational problem.

The apertures were one marker of such reconceptualization, one element in

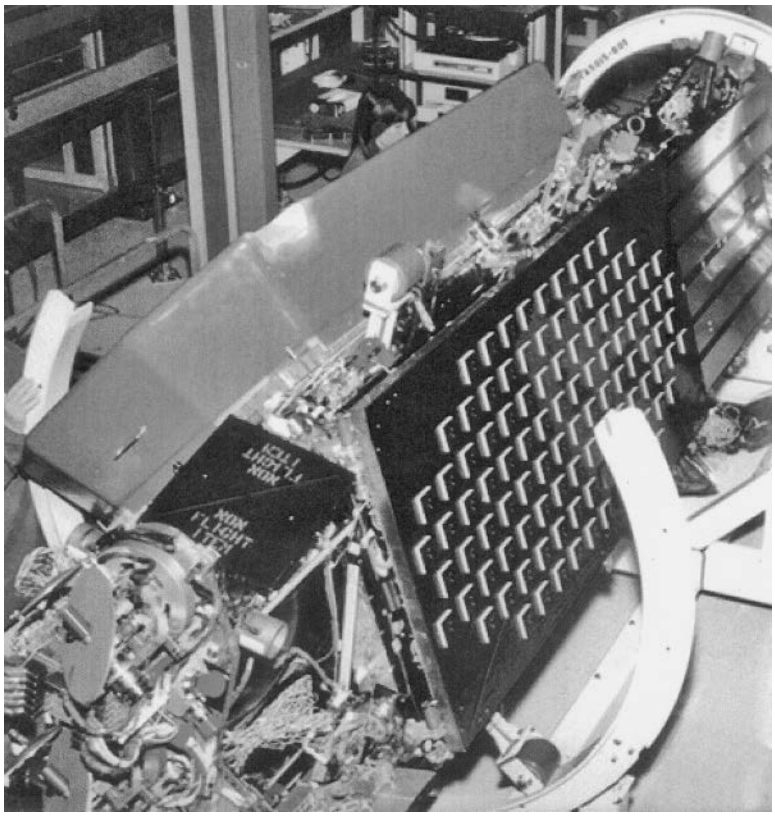


Figure 2.6. This is a satellite close to completion. One solar panel (*right*) covers one of the apertures. The housing (*left*) protects the other aperture as final interior components are installed and workers test the interior electronics, before they eventually append the second solar panel. Another cost-saving approach of the project was to minimize the need for high-level clean-room environments and garments such as hairnets and shoe booties. Used with permission of Motorola Solutions, Inc.

rethinking workflow in the factory as a whole—indeed, in developing the design of the factory itself. The primary reinvention was to make satellite manufacture more like an assembly line rather than as one-off craft manufacture. Seen from the long history of manufacture such reinvention was trivial, but the one-off in spacecraft production was the essence of Cold War practice. The apertures reflected the decision to have satellites, mimicking the flow of the assembly line, move through the factory as horizontal platforms (carried along on dollies, as seen in the image), allowing factory workers easy access to the interior of the

spacecraft to perform a sequence of tasks. This contrasted with the Cold War modality of manufacture in which workers climbed in and around a satellite as if it were a building construction project. Such design consideration in Iridium extended to planning for post-assembly testing and fixing below-standard components. As Hillis noted:

> The other thing we did early on, that drove the design and manufacturing, we said, "You must be able to repair anything in the satellite in thirty minutes." When you have a failure, you need to replace it. Whatever's bad, replace it in thirty minutes." Huge driver. Make them [the components] modular enough, had to lay out enough, had them accessible enough. Think architecturally, how do you partition different functions, so you can do that.[74]

Another seemingly mundane example was how to conceptualize and organize work on the wiring for the satellites' electronics—one of the most time-consuming and mistake-prone aspects of production. In this instance, the license to rethink process turned on the notion of "benchmarking," looking at related examples of process activities that demonstrated methods of higher quality and cycle time. For satellite wiring automobile manufacture provided a fruitful analogy as to questions of quality of components and method of manufacture. Hillis noted:

> So one day I said to our guys, we were brainstorming this, and I said, "Tell me something. Other than vacuum and radiation, tell me how space is as bad as the under-hood of an automobile," knowing Motorola made onboard electronics [for automobiles]. So I said, "Think of temperature extremes, shock, vibration, electromagnetic impulses. I mean, name it. That's the worst environment you can think of, just about. We had a couple of so-called parts specialists, and sent them to Chicago to our automotive factory. Said, "Find out what their parts specifications are. That's what we use." It worked beautifully.[75]

The analogy of automobile engine spark plug technology and technique proved constructive:

> From the same people, [we] had this idea of using spark plug wire kind of concepts. . . . People making mistakes in wiring. And so when there were wiring harnesses, first of all, we determined that using the right kind of metallurgy, which we'd learned from those people there, you can use a spark plug-type connector and make it reliable. So you get away from these welded-on cable

joints, which were unreliable, which would get things called "purple plague," where they'd corrode after a period of time, and all those problems.

So, not only did they use the spark plug-type thing, but they adapted the concept even further by saying, "You've got these connections here to be made, from here to here. You make the wires a different length, just like spark plug wires, so you don't get confused on which goes where." Just little things like that contributed to shortened cycle time and low error.[76]

The satellite apertures and methods of wiring, then, were indicators of the broader transformations in play. The US tradition of satellite manufacture, 30 years in the making, developed around state-sponsored big technology. It established particular methods of project management, of the relation between the funding agency and the prime contractor, of protocols for manufacture and test, and a variety of other organizational and technological assumptions. As applied to satellite manufacture, this methodology typically resulted in a time frame of several years for producing a single satellite. For a time- and cost-sensitive endeavor, with the aim of building tens of satellites rather than a few, a new organizing assumption was required: "manufacturability."

This concept did not just affect the spatial and motion dynamics of design and work practice; it also gave rise to decisions on the framing of the project. As noted, a critical criterion was to compose the system from "known," already proven technologies. This choice reflected a constellation of assumptions: of the adequacy of existing communications technologies; of the unpredictable timelines and performance of superior technologies not yet fully developed; and, not least, the established ability to produce and combine known technologies into a working system. Hillis saw this aspect of manufacturability as crucial to the very possibility of undertaking the project. As he and his colleagues knew, the history of state-sponsored Cold War projects that pushed scientific or technical boundaries almost always exceeded expected costs and development times.

I learned a very, very important thing, which I applied to Iridium, and that is, if you're doing something that's considered an invention, never been done before, you'd better try to understand how many things you're inventing at the same time. I applied that to the extreme in Iridium, where I said—and we held to this, almost totally—"We will not invent any technology for Iridium. This concept we're using (and you're taking advantage of statistics, doing system integration and all the other things that I talked about), that's our creative

> part, that's our innovation. We will not use unproved technology." . . . When people would say, "Hey, if we just did this, or use this other thing that shows great promise. These people have this in the laboratory that has ten times the performance," time out. Forget it. We're not doing it.[77]

In a system context, one innovation might lead to a cascade of effects, undermining the project's guiding aim to minimize unpredictability and risk, and their cognates, time and cost.

From the conceptual position of manufacturability, key Motorola engineers sought to question, reconfigure, and adapt the prior set of practices and assumptions of the large-scale project. As noted earlier, this was a response to the perception that manufacture as a socio-technical problem had been undertheorized. In Iridium, this reconceptualization took two specific forms. One was to reject the core assumption of the Cold War project: that each component and spacecraft (or other end product) should be designed and built for the worst-case scenario of failure. The primary manifestation of such thinking placed high emphasis on the testing of each component, each subsystem, and the system in toto to ensure performance at extreme conditions. The Iridium alternative shifted the idea to a probabilistic basis, asking the question, "what assumptions of production will produce a spacecraft and system that will perform as needed under conditions not at the statistical extremes, but in those conditions that, to some margin of variance around a norm, describe the most typical environments of operation?"[78] In this context, failure was not a condition to be avoided at a high cost of time and money, but was to be accepted as a feature.

This led to the second aspect of the Iridium engineering approach: that the entity to optimize was the satellite network, not the individual satellite. Though the failure of an individual satellite was possible, the probability of network failure was substantially less. This constituted not just the perspective of a commercial framework, but also of period globalization: the pressures of technical change and more demanding consumer expectations likely would make Iridium, in this first iteration, of diminishing value in several years. This view of failure, situated in the conditions of globalization, pushed the engineers to think of the constellation as disposable, to be replaced at intervals. Even before satellites were in active production, the engineers began the next generation of the system.[79]

Within this meta-framework of assumptions, the fundamental act of system building was not just to create a series of technical documents from which a technology could be constituted, but also to make analytically transparent the process

by which it would be realized—to understand the intersection of design, components, tasks, multiple inputs, interfaces and interactions between subsystems, workers, and work spaces, in short, to broaden the domain of what manufacture represented as a problem.

Motorola confronted this problem in its semiconductor, cellular phone, and pager businesses—all high-volume production activities bound to the larger tides of globalization. As a response, it pioneered, codified, and promoted Six Sigma as a managerial and statistical technique that addressed challenges specific to that problem domain.[80] Through Six Sigma and Motorola University, Motorola perhaps responded to this situation more deeply than any other company, taking as canonical the idea of an explicit relation between the internal culture of the firm and performance in global, geographically dispersed markets. Six Sigma took formal shape at Motorola in 1986, connoting a philosophy and set of practices designed to recast corporate culture to meet the changing relations among markets, technology, and business.[81] It conjoined several elements: a commitment to analyze any and all business processes and practices (mantra: "nothing is sacred"); an emphasis on the use of statistical methods to ground such analyses quantitatively (hence, Six Sigma—to reduce errors to a statistical variance of 3.4:1,000,000); and to train each employee—from shop floor employees to managers—to use the method and then charge them to reshape their immediate work environments. In theory, all employees had one beacon: to uncover, and then improve, defects in processes or products, technical and nontechnical. The Six Sigma way was a blend of analytical rigor, empowerment ideology, and symbolism—the core of a corporate language intended to fuse together business strategy, technical practice, and individual behavior and commitment. Terminology reinforced the notion that individuals and work teams were the foundation of a larger corporate and international market culture; for example, Six Sigma adepts were designated "black belts" as an analogy with the martial arts and a rhetorical echo of the Japanese challenge. In this framing, Six Sigma was emblematic of the broader literature of corporate improvement in the 1980s and 1990s, in which "soft" methods of management that highlighted culture, values, and individual agency conjoined with "hard" methods more applicable to manufacturing processes.[82]

Such thinking entered into Iridium, through Motorola University and the broader corporate ambience. Yet even when married to Cold War-style big project techniques, the fusion of old and new did not provide a complete template for the engineering effort. In Iridium, for example, the issue of interfaces—thousands

in number—among components, subsystems, and activities, distributed across institutions and geography, needed elaboration deeper than was typical for Motorola's commercial manufacturing. Even when using "known" technologies, as Hillis specified, risk and variability could enter into the effort as technologies, institutions, and individuals intersected. One response was to prepare an elaborate detailing of the interfaces in the project, what was called an "n X n" matrix listing all components and subsystems, cross-checking each to uncover not yet recognized relations that might affect performance across an interface. Such effort built up from below provided a broad picture of the state of the project, one not readily visible through other techniques. But the depth and extent of questioning and data gathering this required indicated how manufacturing as a problem domain had risen in importance as an organizational concern. Through this meta-concern, one can see how a generic social-technological methodology such as Six Sigma and a specific technique such as an n X n matrix were elements in the broader effort to theorize manufacturing.[83]

Returning to the examples of the apertures and wiring in the spacecraft, one can better grasp their place in a larger schema of assumptions and relations. They represented materially a fusion of state- and market-sponsored technology as well as a perceived imperative to respond and accommodate a new genre of market, the fluid competitive arena of the global. Motorola, as did other companies, saw these changes as a call to reexamine assumptions on a broad scale—from the organization of a transnational technical project to the behavior of workers on the factory floor. In this moment, the historical actors saw intimate connections between the minutely particular and global patterns of interaction, among individual workers, the corporation, and transnational markets, among the technical, the social, and the cultural.

To convey a sense of these connections, consider a keyword allied with manufacturability but distinct in its genealogy and meanings: "integration." Integration served as the broader frame that gave meaning to the issue of interfaces just outlined. The Motorola factory in Chandler, Arizona, brought together the various elements of an Iridium satellite, produced by the venture's various contractors and subcontractors, for assembly into a finished spacecraft—a critical, material node in the larger, virtual factory. In the parlance of the aerospace industry the factory "integrated" satellites—a concrete expression of a years-long effort of planning and coordination. "Integration," in the Cold War and after, was and is a term of art in the aerospace industry with deep technical and political meaning. It is the meta-activity of the project, its conceptual and managerial ful-

crum. As a companion to "system" (one usually talks of systems integration), it represents a set of ideas, tools, and actions that will compose a technology from a myriad of sub-technologies produced at multiple institutions, geographically dispersed and with different sets of expert knowledge and skills.[84] The technical documents—trade-off study, PDR, and CDR—mentioned previously were expressions of the idea of integration. Integration presumes planning and control across space and time—from the initial steps of design to the end stages of manufacture. It was instrumental; through systems design, it breaks down the whole into parts and brings the parts together into a finished whole; each action, step, and sub-step all build toward a specific technological end. Through attention to planning, articulated through a sequence of coordinated phases, integration makes the production of big and complex technologies seem routine, and the remarkable social acts of organization required seem unremarkable. What becomes "integrated" thus encompasses institutions, disciplines, people, and material things. But *how* it becomes integrated—the assumptions that inform that "how"—might be substantially different. In the space manufacturing context, and in the context of the norms that distinguished modes of defense and commercial manufacture, Iridium marked a transformational moment in thinking about the "how."

As outlined, Motorola adapted the Cold War legacy in key ways as it grappled with conceptions of markets, the global, and the technological. Through a panoply of system and managerial tools—some already mentioned such as phased design studies and reviews, as well as methods such as configuration management—projects were controlled in space and time. But the Cold War project's guiding principle was hierarchy. The controls flowed from the top of the project down. It only secondarily sought to alter organizational, individual, or professional conceptions of work. As suggested in several ways already, Iridium, in contrast, saw the values, norms, and work of individuals, and in correlation the culture of the firm, as essential sites of action and experimentation, a point of view derived from taking "manufacturability" as a critical organizational concept. The "how" of integration (of systems integration) thus was seen in radically different terms, terms grounded in the emergence, from the perspective of the historical actors, of the global as the defining context of engineering and corporate life.

Early in the project, this was manifested in broad strokes in the rejection of hierarchy as a means of control and coordination. Hillis sought a "flat" structure that empowered employees, from low-level employees, to systems engineers, to managers. As Peterson noted:

> Most of these new people had come from—well, we had a lot of people from other prime contractors, some ex-RCA people, ex-GE people. Most of these people, not all of them, but most of them came from these hierarchical structures. And here we had this so-called somewhat flat structure. They all came here kind of enamored by that. I think it was one of the things that drew them here, in fact, because they were well aware of the problems of hierarchical structures, the approval cycles, the slowness of getting things done in such a structure and so forth. And they felt this instant freedom, so to speak, in this flatter structure and they were drawn to it.[85]

Hillis was tapping into a mantra commonly expressed for more than a decade in the American business world that used "culture" and "individual empowerment" as markers to experiment with organizational change, both in the mainstream corporate world and in the counterculture-inflected ambiance of Silicon Valley.[86] From Peterson's perspective, "any cultural differences seemed to melt away, and everybody embraced this new approach to doing a big project. So people ended up working together quite well in spite of the various companies with their own cultural heritages that they'd come from."[87]

But initially this managerial philosophy assumed a relatively small systems integration group could develop and oversee a project the size and complexity of Iridium. It relied on the belief that careful technical definition of the system, accompanied by detailed analysis and distribution of units of work through contract, would require only a minimally sized cadre of engineers—heavily weighted toward senior engineers, such as Hillis, Bertiger, Leopold, Peterson, and Stamp, attuned to the fusion of methodologies the project exemplified. A flat structure seemed consistent with such a relatively homogeneous workforce. But the complexity of the effort, amplified by the greater detail required by the manufacturability concept, as well as time constraints, increased the number of staff, particularly those of mid-level experience.

The result was twofold. The flat structure stayed, defined by a myriad of teams, each responsible for a particular component or subsystem, associated variously with the spacecraft, launch, the gateways, tracking, telemetry, and control, or the network. Individuals participated in multiple teams, largely self-selecting their involvement and the number they chose to join. This circumstance shifted the dynamics of work, giving mid-level engineers a prominent role. John McBride, one of these latter engineers who worked primarily on launch issues, saw the situation as

an opportunity to take the initiative to fill the gaps in the technical and social work of the project that the "graybeards" either chose not to or could not cover.[88]

At the level of rhetoric, expressions of individual empowerment that accompanied the market turn and methodologies such as Six Sigma are properly viewed with skepticism. But in this particular circumstance empowerment as fact and rhetoric seemed to apply. The flat structure, the sheer volume of work, and the essential nature of the mid-level engineers' contribution made empowerment as value an organizational necessity. The conceptualization of manufacture as a problem domain requiring deeper levels of empirical characterization and assessment as to its meaning for manufacturing outcomes elevated the roles of those closest to the action—the working engineers. The example of interfaces described previously illustrates this socio-technical issue. The necessary detail could only be generated and placed into a larger picture of the state of the project through these engineers' work. Management support of non-hierarchical teams only emphasized the value of "ownership" in the overall project; younger engineers' contributions did not get filtered through layers of management. For McBride and others, it was a distinctive situation: "There was a boundary, but the boundary was basically the limits that were reserved for senior management, the boundaries of ethics, you know, the constraints of scheduling budget and things like that. But there was no graduated scale, you could dance right up to the line between empowerment and employment. Everything in that was empowerment."[89]

These various points on work on and life in the project, of the large scale and the small, can be seen in a series of graphics prepared by project personnel as they described and promoted their methodology to staff, contractors, and, occasionally, professional and academic audiences. As described earlier, the notion of the "virtual factory" (fig. 2.7) captured the large-scale view. The trope of virtual-ness was to convey that these heterogeneous, geographically dispersed institutions were linked by a common set of technical practices, behaviors, and outlooks, no matter their location or cultural positioning. This was the import of requiring project engineers and contractors to go through coursework at Motorola University. Such effort also was reinforced by leading personalities in the project—Durrell Hillis, Dannie Stamp, David Montanaro, Andrew Feller, and others—who believed fundamentally in the necessary correlation of the details of work practice, culture, individual agency, and the global condition of the 1990s. Thus, the factory as trope carried important meaning, strengthening the idea that the project established new social boundaries, drawing in and redirecting elements

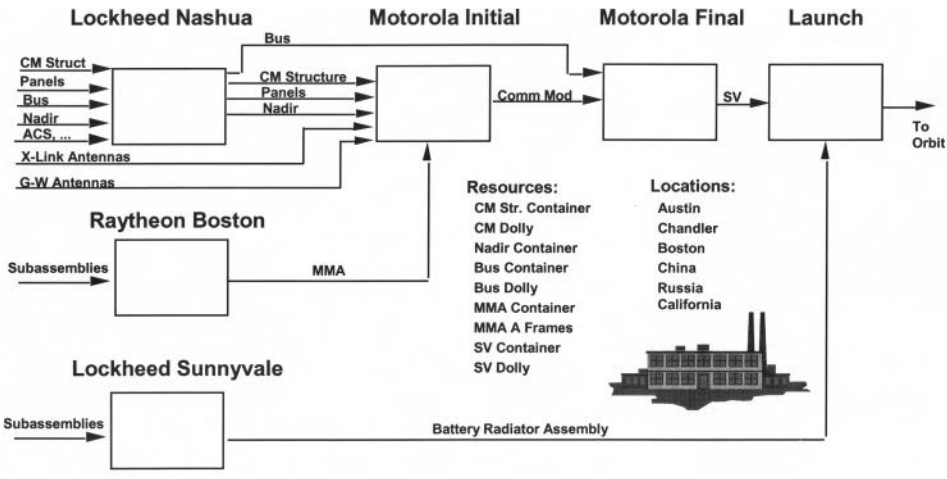


Figure 2.7. The "virtual factory" concept, emphasizing how institutions and technologies, geographically dispersed, are coordinated through the project and share a common set of goals and practices. © Motorola Solutions, Inc. Legacy Archives Collection. Reproduced with permission.

of other institutions, into a substantive community—a set of actions essential to executing a project technically and politically global in scope.

The emphasis on process—that is, project actions analyzed; broken down into constituents; reconfigured for the market ends of cost, schedule, and quality; a cycle iterated again and again—was the key departure from state-oriented project management, a distinction that the Motorola engineers and managers themselves highlighted. The reams of data, such as that generated in the analysis of interfaces and the n X n matrix, provided a highly detailed characterization of project work. This became encapsulated in a database called the bill of process (fig. 2.8), listing thousands of discrete process steps. Then each process step (fig. 2.9, an "exploded" view of one process activity) specified the required information, material, facilities, and time to undertake the step. Such information performed two functions. One was to allow specialists such as Andrew Feller to run a discrete simulation analysis—a technique for assessing the statistical characteristics of the entire process, whether all the planning and design would meet acceptable parameters of quality and time. These process tools also highlighted the role of the individual—from low-level subsystem tester to project manager—in project culture. In figure 2.8, note the column designating individual names ("ownership"), which were assigned to each process step (for

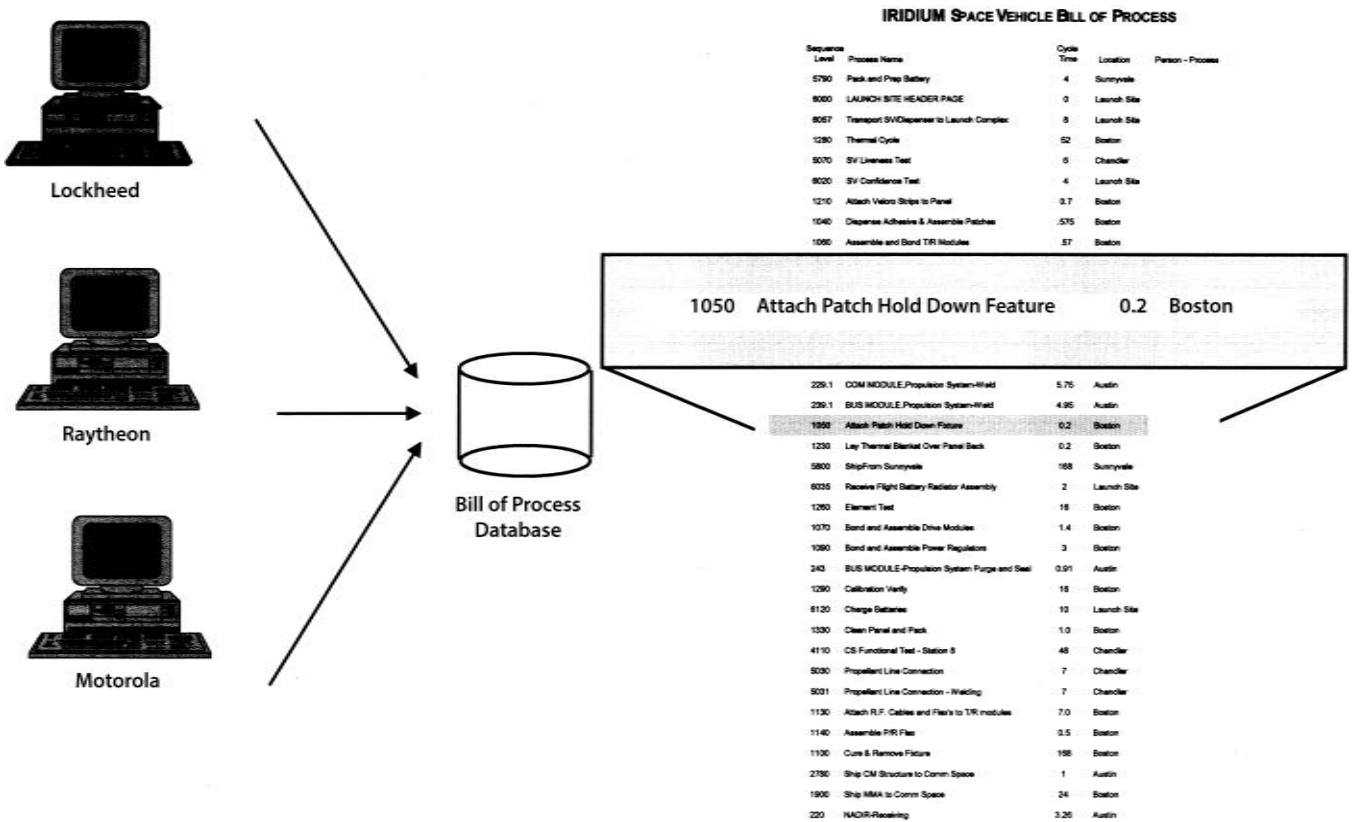


Figure 2.8. Database sample, indicating the management effort to specify, name, and attach responsibility for each individual action required in the assembly of a satellite. Used with permission of Motorola Solutions, Inc.

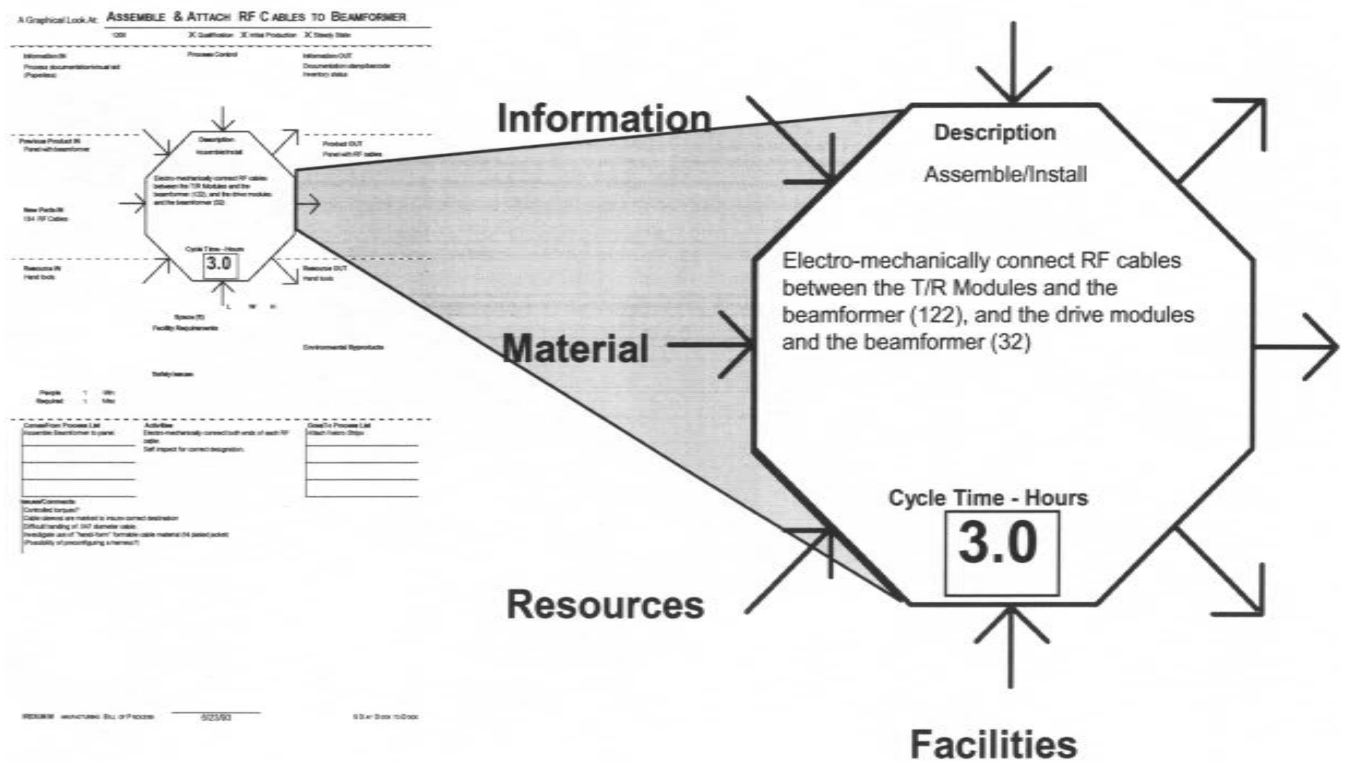

A Graphical Look At: ASSEMBLE & ATTACH RF CABLES TO BEAMFORMER
Information
Material
Resources
Facilities
Description
Assemble/Install
Electro-mechanically connect RF cables between the T/R Modules and the beamformer (122), and the drive modules and the beamformer (32)
Cycle Time - Hours
3.0

Figure 2.9. For each process step, the "process icon" specified the information, material, facilities, and time required to perform the step.
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reasons of privacy, these names, originally included in the diagram, have been deleted).

Inherent in this conceptual framework was a relation between process and the notion of the individual as agent. Process stood for the larger structure of the project and its goals and those of Motorola as a corporation. Though process, as suggested in figures 2.8 and 2.9, might be deconstructed into units suited to individual control and agency, the question lingered as to the extent and meaning of that agency. At its core, the process / individual narrative was a claim as to the nature of the workplace in globalization: that corporate success depended on the recognition of the individual as an agent and holder of values, perhaps different from those of the larger corporation. It was, too, to make a claim about the ecology of knowledge in the corporation: that it was not rigorously hierarchical, flowing down from management or Motorola University, but was a collective system in which individuals, in a limited fashion, were sources and producers of relevant corporate knowledge. The aim was to acknowledge such autonomy but direct it toward corporate interests and culture.[90] This is a familiar story, threading through the history of industrialization. But in the global moment of the 1980s and 1990s, this insight, for the historical actors, took on special significance, one requiring broad, organized intellectualization.

This was one purpose of Motorola University and its course offerings. Though the university was a necessary device for the organizational shaping described here, it was not the only vector for reorienting life in the project. Equally relevant in advancing the tight linkage between process, culture, and individual agency was the work of David Montanaro and his manufacturing design group. They had an everyday presence, able to augment the training of Motorola University, but gave more emphasis to the maxims of "lean manufacturing" than to the more formal trappings of Six Sigma. In its own way this effort was a testament to the problem of conceptualizing the role of the individual in corporate life. The emphasis on mantras, on exhortations, indicated the degree to which shaping individuals to the culture of the project was a retail effort, organized around simple guides to behavior. As Feller noted, their aim was "to spend as much time on relationships as technical issues" as a means to achieve the project's ends.[91] The emphasis on quality was the same as in technical tools such as the bill of process, but the approach was directed at an individual's social and emotional attachment to fellow workers. One aspirational maxim was "5 day dock-to-dock"—a goal of having satellite parts come in the backdoor of the factory and five days later a completed satellite come out the front. The maxim captured the project's intense

focus on time as a determinant of success and sought to appeal to an individual's commitment to the effort's larger goals. One of the interesting facets of Iridium was Hillis's decision to put Danny Stamp (with his air force project management experience) in line authority for manufacturing and place Montanaro in a staff position, who then had to lead by persuasion. Hillis captures this in part:

> David Montanaro . . . you know, later on, was not a senior member, at the top of the organization . . . but he played a key role, early on, of getting people like Andrew Feller and others in place, some bright, really bright young people that were well-schooled. I mean, we got people right out of MIT. We got some really talented people, like Andrew and others, that had the latest concepts of manufacturing and quality and cycle time and so forth, as opposed to people who were so, you know, just so ingrained in doing things the old way. Because we knew we had to do things a totally new way. In the factory, we knew we had to have a very short cycle time. You cannot put the system together by building a satellite the way it was built before.[92]

The attention to process, individual agency, and culture was a mutually supporting enterprise. The process emphasis allowed a connection between a set of technical practices and a symbolic frame of shared values and commitments—a frame that served to define work life at local sites and connect it to the global structures of the 1990s market: that you could do well and do good, make a profit and spur a liberal democratic remaking of the world—a reflection, for many of the engineers, of the idealism that inhered in their work. Motorola, and other firms, tailored the concepts of process and culture to meet the perceived challenges of global markets, a strategy that only intensified with the collapse of the Soviet Union. In Iridium, this concept of culture associated with Six Sigma and lean manufacturing led to a new methodology of project execution, a new means to create large-scale technology in the market and global context of the 1980s and 1990s. More broadly, these developments signaled the continuing elision and shifting over the decades of the Cold War and after of a variety of conceptual and social boundaries, including those relating to markets and states, academia and industry, and the firm and individuals.

Systems engineering conjoined with a Motorola ethos of commercial manufacturing seemed to make ideals of non-hierarchy and the enhanced status of individuals plausible—as ideals that sought to correlate perceived notions of the global with global corporate life. It combined the intellectual power of systems for conceptualizing complex, spatially distributed projects *and* the notion

that new methods of producing quality down to the subsystem and component level would give the tasks of manufacturing and integration rigor without the encumbrances of Cold War ways of doing things. Things, literally, would come together—in the project and in the project as an expression of the global. Such aspiration held from 1990 to 1995, but with lessening force as the engineering effort moved from conceptualization to actual manufacture, as paper-to-real-world complexity and the need to manage a range of subcontracted work increased. Peterson was emblematic of the lament of transitioning back to a more hierarchical organization, less reflective of but not extinguishing those values attached to culture and the individual:

> I remember Bary and Durrell at one point thought they could pull this endeavor off with somewhere between 500 and 1,000 people, but it just didn't happen that way. . . . A lot of subcontract people were in the building with us, just like one of us. Then we had people working actually around the world on it. We had people in India running software. We had people in Maryland, the ASICS Corporation, working at their facility. Lockheed was now back at their facility working. There were people all over the world working on this thing. I think at one point we had over 4,000 people working on it.
>
> I don't like hierarchies. I like flat and I like teams. I like that idea of Durrell's. But so I was disappointed, but I understood. You saw the other thing wasn't working, so something had to change. So the only thing they knew to do was to go back to something more akin to what they'd come from. . . . If it's a small thing, yeah, you can be more loosey-goosey and make it work, but not with something as massive as this. By '95, the flat structure was pretty well gone.[93]

Though Peterson perhaps overstated the thoroughness of this transition, the tension between an organization defined by a flat structure and teams and one defined by hierarchy was indicative of the global moment, of how corporate actors might set the relations among the firm, notions of culture, and the individual.[94] Such consideration, as noted, derived from the perceived meaning of the 1980s Japanese manufacturing challenge in electronics and automobiles—of the close interrelation between quality and the culture of the firm. The Japanese way, in broad outline, de facto became the critical exemplar for correlating the firm, work practice, and performance on a global scale.[95] Embedded in this exemplar and in those cited for Iridium was an assumption about teamwork and group problem-solving—that is, that culture as defined by behaviors and attitudes was central to the project.

As presented earlier, this interest in and commitment to notions of culture in the corporate setting was not idiosyncratic to the working level or an expression of Hillis's own managerial ideas, but permeated the corporation in the 1980s and 1990s, with its prominent expression the establishment of Motorola University and the promotion of Six Sigma and related culturally inflected methodologies in the life of the organization. One might view these developments through the long-running discussion beginning with Max Weber, Thorstein Veblen, Frederick Taylor, and Henry Ford on the relationship among workers, managers, bureaucracies, markets, and states and on the striving of modern institutions for rationalization and efficiency. The difference, perhaps, is that in the 1970s and 1980s many disciplines and social groups began to invoke culture as a descriptive and analytic category.[96] Fredric Jameson in a seminal 1991 book observed that for authors committed to the idea of a postmodern condition, culture had become a "veritable second nature." By the mid-1980s, Motorola came to a similar point of view—but framed in terms of the technical, organizational, and business interests of the corporation. Culture and the rhetoric of culture became both a fact of the world *and* a strategic tool to create new ways of corporate life. It was a rhetoric that centered on giving individuals as autonomous agents a distinct social standing in the corporation—even if the language of autonomy never matched day-to-day reality. This corner of experience, in its idealism and its limits, was part of the period's overarching zeitgeist, in which the problematizing of manufacturing was entangled in the larger fabric of global change and contestation.

Chapter Three

The Global and Iridium the Business

> The benefits that flow from the provision of mobile service by LEO MSS systems are substantial, owing to their ability to provide global dialtone . . . [these] systems will offer the same capacity and quality of service to developing countries as to the industrial world, including the people living in the rain forest, the vast deserts and steppes, and in the polar regions.
>
> COMMENTS OF MOTOROLA SATELLITE COMMUNICATIONS, INC., BEFORE THE US FEDERAL COMMUNICATIONS COMMISSION, 1994

> Remember, this [Iridium] is a little bit before people thought that the world was one big market. It was definitely before that. So, Europe was still an island, not to mention that Russia and China being completely isolated. So, there were some big holes in the story.
>
> LEO MONDALE, ORAL HISTORY INTERVIEW

As a design and manufacturing problem, Iridium possessed a particular narrative of the global, one centered on concepts of system, process, and control over technical and workplace realms. Though the numerous variables that composed the venture might prove unruly and lead to disruption in planning and control, the basic presumption was that engineering practice could impose order and enable the execution of a global-scale project. Such presumption drew sustenance from years-long experience in undertaking complex projects in defense and commercial contexts. The Iridium engineering notion of the global was highly abstract and explicitly geographically grand: think of the schematics of the satellite system embracing the Earth or of cellular patterns the satellites radiated onto a featureless planet. Yet it also was highly local, seeking to reorient the practices, behaviors, and values of workplaces and individuals. Each complemented the other and each was bound up with, yet distinct from, that other more visible register of the global: the messy, fraught geopolitics of the 1980s and 1990s.

It was this expression of the global, with its multiple, contending vectors of period change, that Iridium the business directly confronted. Seeking to operate on a broad transnational scale, the venture could not help but be in the thick

of this ground-level jostling among national political institutions, international regulatory entities and trade regimes, investors, contractors, partners, banks, and corporate competitors, all defined by the ascendance of market ideology and the reoriented geopolitics in the wake of the Soviet collapse. The two opening quotes capture some of the flavor of the moment—of a US multinational corporation ambitiously seeking to provide a "global dialtone," pitching the effort, at least rhetorically, as a market-oriented nod to the long-running conversation on developed-developing world relations. Yet the realization of this objective required vigorous political effort: the world was not yet "one big market" on the fully global scale envisioned by Iridium.

In pursuit of their goal, in the United States alone, the Motorola and Iridium actors regularly passed through the White House, Congress, the Department of Defense (DoD), the State Department, the Commerce Department, the US Trade Representative, the Federal Communications Commission, or FCC (regulator of communications in private industry), the National Telecommunications and Information Administration (regulator of communications in the government realm), and the National Security Telecommunications Advisory Committee. The latter, created in 1982 by President Ronald Reagan, was to ensure that as the push toward telecommunications deregulation increased, private firms and US officials were in conversation on "policy and enhancements to national security and emergency preparedness."[1]

President Bill Clinton's administration provided a favorable climate for the Iridium endeavor. In the area of space, he campaigned on a platform to "move beyond the Cold War" and to "improve the American economy through space."[2] But there also were challenges. With all these points of contact, many with high stakes in terms of economic and foreign policy, Motorola and Iridium could not help occasionally getting entangled in partisan tussles, especially as economic and national security goals jockeyed for primacy and Clinton himself came under relentless conservative attack.[3]

In its navigation of this landscape, the venture reflected and helped compose the ideas and practices of the global then taking shape—because of these multiple points of contact with key arenas of decision-making and because political and corporate actors, in the United States and internationally, took Iridium as an exemplar of the changes under way, of the economic and social possibilities of the market creed. It was that very conflation that gave the project its cachet. As a literal and symbolic expression of the global, Iridium encompassed the enthusiasms, ambiguities, tensions, and resistances in the shifting relations among

markets and states, developed and developing nations, and the United States as the dominant post–Cold War power and actor on the world stage.

As a business, Iridium confronted this tangle of relations through a core feature of its design. In a technical sense the system could cross terrestrial borders with ease, yet its operation had to be balanced against the realities of the political landscape in the post–Cold War world. The space system's "stand-alone" capability—its network of Earth-encircling satellites providing direct service to handheld phones—tested longstanding national schemes that regulated communications. For much of the twentieth century, most nations controlled communications, either directly through state-run entities or through designated corporate monopolies (as with, until the early 1980s, AT&T in the United States) and through regulation. The system's architecture raised the worry that the corporation and its customers might seek to "bypass" established national infrastructures of control and revenue generation—that the global could circumvent local power and identity. Yet Iridium (or any communications venture) needed permission to send signals in and out of any national territory. For a service with global ambitions, seeking to initiate service everywhere and in one fell swoop, this meant the negotiation and arrangement of permissions on an unprecedented scale. This process had a clear political valence: a project of a prominent US multinational corporation seeking presence and acceptance in each of the world's nation-states. Even with the move in the 1980s toward privatization of communications, states carefully examined granting control over communications within their territories to foreign firms, making legal and regulatory accommodations essential to the venture. How to regulate communications—telephony, television, the emerging world of the Web—was a prime issue in defining state sovereignty, especially for developing nations in their relations with the West.[4] Important, too, in post–Cold War geopolitics was how Russia and China, key investors in the project, might balance their national interests with the globe-spanning, US-organized venture.

When Motorola announced Iridium in June 1990, there did not exist a regulatory framework that could legitimate the enterprise—in the tightly managed world of radio communications no spectrum had been allocated for satellite cellular service (soon to be known as MSS, or Mobile Satellite Service) by the appropriate international and national bodies, no specific authorization for Iridium (as a business entity) to provide such service. The necessary political acts had to be negotiated and constructed—first through the FCC and the United Nation's International Telecommunications Union (or ITU, empowered to establish international spectrum allocations), then through each individual country within which

Iridium planned to operate.[5] Thus, the venture was inseparable from the effort to embed it in a new legal and regulatory framework aimed at giving broader latitude to market values and projects. It was part of a post-1970s trend that loosened and redefined the historic, strong relation between communications services and individual nation-states, and, concomitantly, created particular notions of the global. These steps found connection with related areas of regulation and policy that composed the post–Cold War market system—ranging from redefinitions of the International Telecommunications Satellite Organization (Intelsat) and the International Maritime Satellite Organization (or Inmarsat, another Cold War-created international treaty organization to facilitate satellite communications on the oceans) to a major reorganization of the structure of telecommunications through the Telecommunications Act of 1996, to the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO).[6] In each instance, advocacy using public relations, lobbying, and the tactics of political campaigning, primarily by Motorola, with the aid and support of the US government, helped secure the new legal and regulatory framework. These seemingly extra-market acts helped birth a specific market-oriented global order. Ideology, engineering, and a national and international political framework of regulation existed as a tangled whole in Iridium, mutually defining the project and, in selected fashion, the emerging world of a late twentieth-century global increasingly shaped by market values and the political-economic importance of communications therein.

This larger problem of reengineering transnational legal and regulatory frameworks, not surprisingly, intersected with the business particulars of Motorola and Iridium in several ways. Motorola had plants and sales offices in tens of countries and already established working relationships with government officials in most of the countries from which investors came. These preexisting relationships served variously as symbols of Motorola's standing as one of the world's vanguard high-technology companies, tacit proof of Motorola's institutional wherewithal to execute a global project, and an in-nation resource for negotiating support for Iridium. Motorola's broad international emplacement was especially valuable in China, where the company had a well-established business network, and in India, where the state maintained rigorous oversight of foreign investment. Motorola's prior history also could create impediments. In Europe, Motorola frequently was viewed as a competitor to continental firms, and thus the Iridium proposal received an uneven, sometimes antagonistic reception, particularly in France and the United Kingdom. Yet even with such uneven political leverage, the company's

broad transnational emplacement and standing as an exemplar of innovation was a vital asset in negotiating for a new landscape of market-friendly regulation.

As Iridium started, these Motorola relationships became entwined with a key organizational feature of the venture. Most investors, in return for providing equity, also acquired the right to establish a "gateway" in a given geographical area (as small as North and South Korea or as vast as China, most of Africa, or South America). The gateways were technical and business constructs. Each gateway connected the satellite system to the public-switched telephone network and served as a commercial hub for the venture in the geographic region assigned to an investor (or investor group). As a technical system, with its in-space switching and routing capabilities, Iridium did not need more than a *single* gateway to provide connection to the sprawling network of transnational terrestrial telephone communications. The gateways were a concession to the everyday, messy realities of composing the global from many instances of the local—as a matter of spreading financial risk and as a means of creating local and regional political support. Such a structure facilitated political support for regulatory actions favorable to the venture before international bodies, such as the ITU, as well as in adjusting state regulatory structures to accommodate a US-led corporation's incursion into entrenched national frameworks of control over communications. The gateways, and the investor relations they embodied, were a realpolitik augmentation of Motorola's significant but bounded corporate persuasive powers.

The gateways were designed to be independent business entities with their own equity-holders and boards of directors, and were structured like franchises, giving investors the right to sell Iridium services in their geographic area, usually through established customer-oriented storefronts such as cellular retailers. Through the gateways, Iridium's investors took, at least on paper, an active, not a pro forma, role in the business. Corporate Iridium's financial health depended on the business acumen and skill of the gateway owners and operators. These geographically dispersed institutions thus served as a nexus to join Western business values and culture with local political and business culture. The result was a mix of autonomy and mutual dependence among the investors as they collaborated through the Iridium board and in the gateways—a political arrangement the historical actors deemed as necessary to creating a global enterprise. This set of relations, too, gave Iridium its post–Cold War glow, reflected in *WIRED* magazine's complimentary designation of the project as the "united nations of Iridium." The moniker was a hosanna to the idea that markets were a plausible alternative to achieving social and political progress in distinction from the post–World War

II nation-state-centric United Nations and its methods of advocacy for equality and human rights. Yet this "united nations of Iridium" so essential to the political dimensions of the venture proved to be a critical business weakness by adding organizational and cultural complexity—and the frictions that came with them.

But Iridium was not all about the intensified market world of the post–Cold War moment. Its varied manifestations of the global also yielded a US military gateway—not surprising given the project's origins, but symbolically and politically uncomfortable given the venture's association with end-of-the-Cold-War market populism and liberal democracy. Motorola, through a contract with the US Defense Information Systems Agency (DISA), built and operated a separate gateway for the US government, with the military as primary customer. Located in Hawaii, the gateway allowed for an organizational separation of government communications traffic from Iridium's commercial flow. In addition, Motorola built special satellite phones for its government customers that allowed for encrypted communications. Preexisting structures of the Cold War thus found a home in the new market order of the 1990s.

This chapter explores these contours of the global, intimately bound to issues of technology, but focuses on the considerable financial, legal, and organizational labor required to mesh international frameworks of communications regulation and politics with Motorola's capacities as a corporation and its creation of Iridium as a business planetary in scope. Iridium embodied both the process of change in the post–Cold War world and the specific attempts to create market-favorable frameworks in multiple nations and in international regulatory forums. The narrative focuses on these themes, giving greatest emphasis to Iridium's development from 1990 through 1993 as Motorola sought concurrently to secure national and international regulatory approvals and acquire equity capital from a range of US and non-US investors. This period set the structural framework for the venture as well as the fault lines among Iridium (as independent company), Motorola, and the equity investors—the resulting tensions of which came into clearer view as the need for additional financing through bank loans in the mid-1990s challenged all parties' conception of the global.

Framing the Global in the Early 1990s

In April 1990, two months before Motorola's multicity, international announcement of Iridium, the economist John Williamson published the article "What Washington Means by Policy Reform."[7] The analysis aimed to discern the assumptions that informed recent US government actions in Latin America as it

pushed regional economic and political change, the purpose of which was to realign state interests there with those of the United States. Williamson tentatively, but perceptively, gave these assumptions a name—the "Washington Consensus." Through the 1990s, Williamson's coinage, and the assumptions it identified, became widely entrenched among political elites as the preferred economic-political prescription for ordering international life.[8] It embraced as its organizing tenets free markets, deregulation, privatization, state policies of anti-inflation austerity and tax and spending cuts, and the opening of national borders to flows of trade and finance. It was, in short, the neoliberal agenda for setting the proper roles of states and markets, with the former granting the latter much greater latitude of action. Williamson saw his analysis as marking a historical moment: to recognize that a set of policies argued for and preliminarily implemented in the 1970s had reached a critical moment of coherence by 1990—a coherence that neatly resonated with Francis Fukuyama's "End of History?" reflections. By the end of the 1990s, this consensus had cleared the field of political and intellectual competitors. As noted by the historian Jeffrey Frieden, at that moment "there was more agreement on economic doctrine than at any time since 1914. Communist, radical, developmentalist, and popular alternatives to orthodoxy were weak or nonexistent; it was difficult to find supporters of planning, import substitution, or wide-spread state ownership anywhere in the world. . . . Few questioned the general superiority of markets as mechanism of economic allocation."[9] Though the grand coherence of change through the 1990s suggested by these bookend characterizations may be overstated, it does indicate that a powerful ideological movement was under way, one that had gained greater credence through perceived failures of socialist economic models and with the collapse of the Soviet Bloc. As an exercise in historical periodization, Williamson's paper is noteworthy on two levels. With the United States as lone superpower, Williamson took it as unremarkable that Washington was the locus of this doctrine and that the political sway of Washington elites made *them* the unremarkable arbiters of what constituted a consensus for the ordering of international affairs. But yet in the breadth of this claim, he regarded this doctrine, and its reach, as formative, not yet at its apogee; even Latin American neighbors long familiar with the effects of US influence tugged between adopting and resisting the prescriptions of the Washington Consensus.

This sketch provides a broad context for understanding the world Motorola confronted as it began Iridium—as a participant in a neoliberal transformation, primarily US-led, that though powerful still had the task of reconfiguring na-

tional and international institutions in support of markets. As historical fortuity, in this early 1990s moment, Motorola was near the height of its power and stature. It had, as already noted, tens of facilities and offices spread over every region of the world. Through the 1980s, it had engaged the Japanese challenge in the crucial economic area of semiconductors and retained a prominent position as a producer. It pioneered and was the preeminent corporation in the burgeoning new consumer arena of cellular telephony, in the development of both ground infrastructure and phones. Part of its stature came from internal change that made these accomplishments possible, most notably, as discussed in chapter 2, through revamping thoroughly its manufacturing processes to improve quality. In 1988, such effort resulted in Motorola receiving the first Malcolm Baldridge National Quality Award, a congressionally created program, administered by the National Institute of Standards and Technology, to promote quality in US corporations—an indicator of the political concern over the United States' seemingly faltering ability to compete with Asian companies and their supportive national governments. Motorola's success in this critical area made the company a cynosure of American resolve and US-style capitalism.[10]

In closely allied fashion, external efforts burnished the company's position. Through the 1980s, it was active politically, pressing competition issues, through its Washington, DC, office and through corporate headquarters in Schaumberg, Illinois, with the US Trade Representative, the Commerce Department, the Department of Treasury, and Congress. It also played a major role in the Semiconductor Industries Association (SIA), a trade association that included US firms and subsidiaries of foreign firms, as a means to work through international trade problems. In this period, Robert Galvin, then CEO and chairman of Motorola, served as head of the SIA, reflecting his stature as a national business leader in addressing trade issues in Asia, with an emphasis on opening up Asian markets for US products. Through the 1980s, this goal already had become a key element of Motorola's business strategy. As these policy issues played out, Motorola pushed to establish manufacturing facilities in Asia, creating a subsidiary in Japan and becoming an early and prominent mover in negotiating entry into the People's Republic of China. In tandem, Motorola established a manufacturing facility for pagers and cellular phones and a corporate office in Beijing; in the process Galvin became one of the few favored US corporate executives with ready access to China's political leaders. By 1991, more than 20 percent of Motorola revenues derived from China and Japan. Overall, more than 50 percent of its revenues were generated outside the United States. Thus, at the time of Iridium, Motorola was

at the leading edge of the political and economic jockeying for more open markets in the major trades regions of the world, triangulating its objectives through state-to-state, business-to-state, and business-to-business interactions—all of which aligned, in large measure, with the policy and ideological understandings of the Washington Consensus.[11]

The story of semiconductors and the increasing consumer demand for cellular technology highlighted the historical moment's push for markets more neoliberal in character. But a starker contrast between state and market conceptions of the world prevailed in the area most important to Iridium: international communications, particularly by satellite. In 1990, Intelsat and Inmarsat stood as exemplars of state-controlled markets, the former to serve land-based users and the latter for those on the world's oceans. Created respectively in 1964 and 1979, each was an international treaty organization, under United Nations' auspices, the members of which were nation-states, nearly all of which in turn controlled and provided communications within their borders through government or government-sanctioned monopolies, so-called PTTs (Postal, Telegraph, Telephone).[12] The satellite communications services provided by Intelsat and Inmarsat presumed and were integrated into this matrix of state-centric markets, a political-economic arrangement that although beginning to be questioned still was largely intact.

Critique of this arrangement came, of course, from neoliberal exponents of free markets, but also from an emerging, alternate model provided by cellular telephony, which operated almost entirely through private companies on a competitive rather than monopoly basis. This was something of a historical accident. The first cellular systems, concentrated in large metropolitan areas, took shape in the early 1980s—the very moment that neoliberal advocacy for markets was gaining substantial traction, especially through the policies of President Reagan and British Prime Minister Margaret Thatcher. In the United States, the dismantling in 1982 of AT&T was an indicator of the changes under way. But satellite communications and the persistence of the PTT model in Europe and elsewhere suggested the distance in 1990 between neoliberal aspiration and facts on the ground.

A rising tide of neoliberal policy and ideology, the still largely state-centric lean of telecommunications, and Motorola's own positioning, ready to take advantage of the former while pushing against the latter, set the parameters of Iridium's possibilities—and from the point of view of its originators the project's significant challenges. Threaded through this was the longer history of disparity between developed and developing nations, West and East, North and South, a geopolitical dynamic made more complex as the "Second World" Soviet Bloc was integrated

into the post-1989 geopolitical landscape.[13] The critical new variable was the heightened acceptance of the neoliberal belief that private capital—the quest for profit—would be the solvent that would facilitate collaboration and partnerships despite past disparities and differences in national interests. Though the meaning of such profit-seeking varied from locale to locale it was sufficient glue to bring the venture's diverse actors into the common cause of the project. Such ideology mapped onto the greater scale of transnational trade in the 1980s—with, as mentioned above, Motorola's own trajectory of non-US sales an indicator.

In early 1990, as Iridium the business began it was an even more rudimentary organization than the engineering project. The latter consisted of 30 to 40 staff; Iridium 5 to 6, complemented by a few contractors. As a venture of Motorola's government engineering group, its principals—Durrell Hillis, Bary Bertiger, and Raymond Leopold—played an active role in the start-up of the business, as did John Mitchell, Motorola corporate president, who for his forceful but careful use of power on behalf of the venture was called "godfather" by the other Iridium principals. The engineering group was based in Chandler, Arizona; Mitchell at corporate headquarters in Schaumberg, Illinois; and the Iridium coterie in Washington, DC, initially sitting with Motorola corporate's Government Relations Office. This choice reflected the need to work the multiple sites of decision-making relevant to creating the political framework to get the effort under way.

Iridium's mix of personnel fit the landscape of challenges: Robert Kinzie, CEO and chairman, had prior experience at Intelsat and thus understanding of the international politics of satellite communications; Jerrold Adams, president, ran in New York City one of the first metropolitan cellular businesses; Leo Mondale, nephew of former Vice President Walter Mondale, became responsible for regulatory approvals, with previous related responsibility at the French aerospace firm Matra; Mark Gercenstein, a specialist in selling the products of Motorola's Government Electronics Division, covered marketing; and William English, a former Intelsat attorney, handled legal and business planning. In addition, Martin Rothblatt, attorney and entrepreneur in satellite start-ups, was hired on contract to assist with regulatory and planning issues.

This nucleus, with some shifting of roles, remained the core of Iridium leadership through much of the 1990s.[14] The two key challenges at this formative moment were regulatory concerns and developing a business plan. On the former, gaining permissions for the venture—as to acquiring spectrum and demonstrating the viability of Iridium as a business—before the FCC and then from the ITU were urgent tasks. Radio spectrum was a scarce resource, in competitive

demand between space-based and terrestrial uses as well as among different geographic regions. Without approval for suitable spectrum (at a frequency effective for low Earth orbit communications and with sufficient bandwidth) Motorola's ambitions for Iridium were meaningless. The regulatory approval, or at least the likely prospect of such approval, would be central to any business plan, which, in turn, provided the basis to attract investors, US and international. As Motorola leadership had determined to make the venture a commercial undertaking, time loomed as the vital criterion—getting as quickly as possible to an operational system, ready to generate revenues. The company had just committed more than $175 million to the effort; the proverbial clock was ticking.

In 1990, when Motorola trumpeted Iridium, it had not yet filed a petition with the FCC for spectrum. Equally if not more problematic was the process for gaining international approval through the United Nation's ITU; its World Administrative Radio Conference (WARC), the body that codified international spectrum allocations, only convened at several-year intervals. Its next gathering was scheduled for early 1992, but planning for what to include in the agenda already had begun.[15] As with other United Nations' forums, WARC was a conference of nation-states; individual governments participated in developing the agenda and were the official voting members of the conference, whose final collective decisions had the standing of an international treaty. Corporations played a vital role, but it manifested through their national government representatives—in the case of the United States through the State and Commerce Departments, as well as the FCC. With the rise of neoliberal thinking, governments, especially the US government, saw as a principal responsibility the facilitation of corporate ambitions, which could readily provoke resistance or conflict in the state-centric world of communications.[16] An early task for the venture, then, was to argue for a prominent place on the US agenda for the 1992 WARC. The splashy, global Iridium announcement in June 1990 can be seen not only as a means for Motorola to attract public and investor interest, but also to make obvious the venture's alignment with and value to US policy goals.[17]

The shift from state to market models of providing transnational communications was historically transformative in its scale and in the relative speed with which it happened. As Kinzie noted, as a private company, Iridium "was in a way disadvantaged against Intelsat and Inmarsat. . . . They didn't pay taxes, they had privileges and immunities. . . . They had licenses everywhere. They had a government treaty. So Iridium had to start as a private company and do all of that without the help of governments, without a treaty behind it."[18] The claim of "without

the help of governments" was not fully correct: Motorola's good political standing and lobbying muscle garnered significant US government support, especially at WARC and, a little later, in thwarting Inmarsat from competing with Iridium as that treaty organization planned to join the satellite telephony frenzy and extend its mobile business from the ocean to land service.

But the ideological winds were shifting. As Rothblatt consulted with Iridium, his view was "that all the trends were in our favor, even if the laws were not in our favor at that point in time. I mean, basically, the situation I presented [to Iridium] is that, right now, this system is illegal. No if-and-or-but doubts about it. However, the trends are that this system will be legal, and if we follow the dynamic, if we follow the trend, we'll be fine. And there are many different ways that the system [Iridium] was illegal, and in each way, it could be shown that the trend was in our favor." The "trend" was the move, à la the Washington Consensus, to neoliberal conceptions of state-market roles as Rothblatt perceived:

> in the 1980s and before, definitely before, national sovereignty over telecommunications was absolute. I mean, deregulation was hardly even a word. But it didn't really take a genius to see that the trend was toward liberalization and deregulation. It's been a long, slow trend, but it was an unmistakable trend. . . . As one country after another deregulates, the mindset will be more open to having a non-sovereign entity providing communications within that country.[19]

But Iridium was not merely a non-sovereign entity (as was Intelsat); it was a private venture. For Iridium or other firms in the early 1990s, liberalization and deregulation meant vesting national policy in corporations—or at least to see them as instruments of such.[20] To Tom Tuttle, an attorney who joined the nucleus of Iridium personnel to help with the tasks of getting under way, it was clear that "by the nineties, the notion that competition, not government policy, was going to—and therefore, by definition, competition was going to be corporations, not government entities. Competition was going to be the thing that decided who got to do what, and how well they did, and in that respect, it was going to carry out policy. I mean, people were going to compete for that opportunity and if you won, you were going to be important and get rich." This view not only characterized national policy and markets but also significantly characterized the international arena. Iridium was a key symbol of a larger field of action: "we were taking fundamental U.S. policies, carrying them overseas, and we were going to create, in the markets in which we operated—not 'create,' we were going to promote—market economy, opening situations, especially in a number of places

that didn't allow competition in their communication services and that didn't have cellular phones. We very much thought that we were, and I think the government thought so, too. . . . I mean, it was very much these systems were important elements of U.S. policy, U.S. economic and technology policy."[21]

Such thinking suggests why Motorola was able to integrate its corporate goals in a short time with US governmental planning for the ITU and then in having the United States' active support at WARC in 1992. This played out, too, as the company filed its application at the FCC in the late fall of 1990. Tuttle was one of Iridium's point people in working with the commission and saw the change in orientation: "it was a far different role. The FCC was allocating and setting rules for a scarce resource to be used by competitors, domestically and internationally, rather than just trying to make sure that the dominant monopoly carrier provided reasonable services and fair prices. So it's kind of like sitting around in a room, and you want the best decision on something like that, where you're not going to give it over to the technical people, and you're not going to give it over to the economists, and you're sure not going to give it over to the lawyers. You're going to invite everybody to contribute their piece of it and then try to hammer out a decision that makes the most sense, makes the most common sense, taking all those things into account."[22] Thus, political leanings of the moment provided the means to make "the most sense" of the various professional assessments of spectrum allocation. At the center of such judgments was competition as value and instrument of public policy, elevating the corporation as social actor.

Though issues of regulation and spectrum were central in this dynamic between the state and the market, the scope of adjustment in expanding the role of corporate prerogative brought in a variety of governmental actors and interests: "I mean, because all of them [governmental entities] had pieces of this puzzle. When you're dealing with an international system that depends on frequency allocations, and is going to involve foreign operations and foreign investment and procurement of major technology systems from U.S. providers as well as non-U.S. providers, and is going to involve launches, you know, rocket launches, potentially both U.S. and non-U.S., I mean, you're getting into issues ranging from national security to trade to economic policy to foreign policy to just straight politics. Just a broad array of stuff."[23]

But within this reasonably coherent movement to market ideology, the actualities of getting approvals through the FCC and WARC and of acquiring investors was messy and contested, with outcomes not guaranteed. Though the post–Cold War US government pushed market values, it circumscribed them when they

bumped up against strongly held national security concerns. In Iridium, this came to the fore as the venture sought investments from Russia and China, as well as to use those countries' state-owned launch vehicles to carry satellites into an Earth-encircling constellation. Worries over possible transfer of militarily relevant technologies jockeyed with support for markets and corporations—a conversation that bounced across the Departments of Defense, State, and Commerce, and Congress.

Such issues, importantly, could not be separated from the political climate during Bill Clinton's presidency, in which China, in particular, became a nexus for disputes and partisan attacks. Through the 1990s, commercial communications satellites, including those of Iridium, became deeply entangled in this broader problem of United States–China relations and the sharp partisan exchanges on policy China engendered. In 1997–1998, as Iridium launched some of its satellites on the Chinese Long March, it was accused of facilitating that nation's development of a critical nuclear weapons delivery technology, so-called MIRVs, or Multiple Independently Targetable Reentry Vehicles. For Iridium, fortunately, this dispute occurred mostly after its constellation was in place, then it was subsequently exonerated through Congress's Cox Committee hearings and in a subsequent report produced by the Congressional Research Office.[24] The politicization of this issue led to conservative groups such as Judicial Watch to give special scrutiny to Iridium, seeing conspiratorial intent to undermine and sell out US sovereignty to the Chinese. The "smoking guns" in this critique were the presence on Iridium's staff of Leo Mondale, nephew of former Vice President Walter Mondale, and Lauri Fitz-Pegado, who served as assistant secretary and director general of the US and Foreign Commercial Service, under Commerce Department Secretary Ron Brown.[25] Although such political attacks did not seem to have any material effects on Iridium, it showed that the global ethos had its committed detractors.

The Global on the Ground: The FCC, WARC, and the Private Placement Memorandum

In December 1990, when Motorola filed its application with the FCC, four other companies were waiting to follow suit: Constellation Communications, Inc.'s Aries, Ellipsat Corporation's Ellipso, Loral Cellular System Corporation's Globalstar, and TRW's Odyssey. All these initiatives—including Iridium—testified to the perceived expansive business and social possibilities for privately financed, satellite-based global communications. All would be pursuing approval from the

FCC for use of the same scarce spectrum: 1613.8–1626.5 mhz (later amended to 1610–1626.5 mhz), which in the 1980s had been designated as a global allocation for Radio Determination Satellite Service (RDSS)—a position determination method that aimed to provide a commercial alternative to the Global Positioning System (GPS), then not yet fully operational. That this spectrum might be reallocated to satellite telephony was due to the failing business fortunes of a firm called Geostar, which for several years had been seeking to develop the RDSS opportunity. Such repurposing of spectrum only highlighted that demand for usable frequencies outstripped its supply—one of the primary reasons for adjudicating entities such as the FCC and the ITU. As fortuity for Iridium, Martin Rothblatt was Geostar's founder (partnering with Gerard O'Neill, the Princeton physicist and advocate of space colonies, who became the public face of that company). Though Rothblatt's involvement with Iridium gave Motorola an edge in making a case for its use of the spectrum, it had little practical effect. The very market ideology that was spurring the government-to-private turn in communications meant the FCC would make competition a critical value in its decision process. Thus, all the satellite telephony firms would vie for this limited range of spectrum. Motorola's bold public relations announcement of Iridium six months earlier probably complicated their position before the FCC, giving the other firms time to weigh business prospects and develop their proposals (the commission had set a window of six months after Motorola's 1990 filing for other firms to submit proposals). Although filing a proposal was not a trivial matter, it was a minor investment compared to the potential worth of spectrum should a company be granted authorization of use.

All of this might seem parochial: US firms pleading before a US government entity. The problem of the global, though, was embedded in these national proceedings—beyond the specific business ambitions of the corporations. The FCC served as a point of flexion for marrying the national to the global. By initiating a review of these proposals, the commission lent legitimacy to these aborning corporate plans for a global service—a legitimacy amplified by the United States' dominant political-economic position and by the fact these companies were the first in any nation to formalize such an interest. But there were two other dimensions to the FCC's international sway. One was as the gatekeeper into the US market. To operate in the United States potential foreign firms that might seek to create a competing global service needed to gain FCC approval. Such gatekeeping to the US market gave important leverage to the commission. Its mandate broadly and especially in this historical moment was to facilitate the interests of

US business, thus using its authority to promote US economic competitiveness vis-à-vis other nations. In particular, the FCC sought to outmaneuver its regulatory counterpart in the European Union (EU), which was seeking at this time to assert a stronger, more unified position on behalf of European initiatives in telecommunications.[26] This advocacy role was more clearly visible in the planning for WARC, occurring at the same time as these filings at the FCC. The FCC served as "deputy" to the State Department in preparing for and at WARC. State's role explicitly was to advocate for US interests in the transnational arena; one of its key agenda items was the approval of global spectrum for the satellite telephony ventures.[27] The FCC thus became a critical institutional passage and instrument for making international regulatory structures friendlier to private-market initiatives, particularly those deriving from US companies.

By the time of WARC in February 1992, the FCC had not yet made a determination as to who might receive approval to use the RDSS spectrum or how it might be allocated among competitors. But it had decided, in concert with the State Department, that the interests of the companies collectively should be represented at WARC and that the ITU should designate the RDSS spectrum for mobile satellite services. In preparation for WARC, Congress's Office of Technology Assessment (OTA) organized a workshop in December 1990 of government and industry representatives to codify the US approach to the conference, then further analyzed the relevant background and problems through 1991, publishing in November a report entitled "The 1992 World Administrative Radio Conference: Issues for US International Spectrum Policy."[28] As the report dryly noted, interest in the conference had grown through 1990, "especially in the private sector, which had been developing new technologies and services and saw the conference as an opportunity to get radio frequencies it needed. Lobbying by industry and the FCC's Industry Advisory Committee finally convinced the government to pursue additional agenda items."[29] Foremost among these was satellite telephony through low Earth orbit constellations. Notably, in the OTA's report as it outlined the satellite telephony issue, only Motorola's Iridium was given specific mention among the several proposals before the FCC. Perhaps not coincidentally the OTA only explicitly referenced Motorola as an advisor in its preparation of the report (though multiple companies sat on the Industry Advisory Group).

Informing this web of connections among state and business groups were the values and ideology of the Washington Consensus. The report had sections on "globalization," "privatization and liberalization," and "economics and telecommunications," the assessments of which were presented in muted bureaucratic

style as if the United States was experiencing and participating from afar in these historic changes. It foregrounded communications (particularly global communications) as a distinctive good, able to address multiple problems through a mix of market and liberal social values: "as a facilitator of economic development, as a source of global competitive advantage, as a provider of social and welfare benefits, as a contribution to reducing to regional disparities, and as a provider of information for the general elevation of the population."[30] But then the report made the claim that these "have not been the dominant considerations in the formulation of national telecommunication policies," referring obliquely to the tradition of state-centric communications policy. In contrast, as indicated by the issues before WARC 92, the report's narrative saw this as a new historical moment. The market with its global arteries of connection now was the necessary point of orientation to achieve these desired capabilities or results—and as a corollary the nation-state was receding as the means to these ends: "for the future, with information and knowledge becoming strategic resources, and telecommunications becoming the primary means determining their availability, a policy framework for making telecommunications a truly universal resource will need to emerge."[31]

Such idealism was rhetorically familiar and had been rampant since the mid-1970s as computer and communications technologies increasingly reached into everyday life. But it co-existed with the practical dimensions of implementing the global; business as backbone of the market was the primary referent. Telecommunications was the "basis for improving an organization's internal efficiency in an expanding global market" and enhanced competitiveness by facilitating "exchange among the many different locations of transnational corporations around the world" and among these corporations' "suppliers, customers, and . . . network of business relations." Then the perspective flipped from the corporation to the consumer; all this transformation and effort made spectrum "a strategic resource for the future development of radio services and products for the consumer."[32] It was that consumer-citizen who, at least in rhetoric, stood as the agent and beneficiary of the market's social and economic good works. In its dry, unexhilarating prose the report melded the main tenets of the neoliberal outlook, conjoining markets, consumption, individuals as vague liberal political agents, and the desirability of fluid movement across the global stage, and, not least, situating this ideology in an unfolding future of humanity's uplift. Telecommunications was the essential lubricant of these connected, moving parts. All of this served as the preamble and context for the US presence at WARC: to advance the overlapping interests of government and business in a global political economy.

As the FCC approval process churned and negotiations over the US agenda for WARC proceeded, Motorola sought to give meat to a business plan—one that bolstered its position before the commission (and by extension to US advocacy at WARC) but more importantly articulated a concept for the business that investors might find attractive. The result, in September 1991, was the Private Placement Memorandum (PPM), a formal legal document required to solicit prospective equity investors, prepared primarily by Motorola corporate and Goldman, Sachs, & Co., hired to provide financial guidance to the venture.[33] It described the core business idea, the technology, the perceived market, the role of Motorola and investors, and the venture's risks. It complemented another business move of a few months earlier: establishing, under Delaware law, Iridium as a corporation, fully owned by Motorola. Potential investors in the enterprise would be purchasing ownership shares of this company.

Although Motorola at this point had been refining the technical aspects of the venture for four years, it had not yet settled on a final concept for the business. The PPM was written so as to admit two possibilities. One reflected the ambition seemingly presented in the 1990 announcement of the project: that Motorola itself, and subsequent investors, would build the system, operate it, *and* provide the service directly to customers. The other option recognized Motorola's strengths and weaknesses. Motorola existed primarily as a manufacturer, not as a provider of retail services. Iridium as a business then might *only* be to provide the infrastructure, which would be leased to another business better positioned to manage the complexities of telecommunications retail on a global scale. This included not only business details such as points of sale for phones and service or creating methods for apportioning billing charges that spanned multiple national jurisdictions but also the acquisition of licenses to operate in each country. Such expertise was not Motorola's forte, yet it would be essential to the success of an idea to which Motorola already had committed millions of dollars and the time of top engineers and management.

What was common to both concepts was Motorola's own designation in the PPM as a supplier to Iridium of the satellites, gateways, and phones and as the operator of the system once in orbit. The core of Motorola's own involvement, then, was, at a minimum, to profit through the transfer of resources from Iridium the company to Motorola—the bulk of investor equity raised for the venture would be to support this pass-through. If, once operational, Iridium was successful as a business, Motorola would enjoy a second stream of profitability. A not insignificant part of the PPM described the several contracts that would structure the

Iridium-Motorola relationship, as well as the guarantees, responsibilities, and limits to liability proffered by Motorola and, in turn, to what investors were entitled. Indeed, a first iteration of the supply contract was included in the PPM. This proposed business structure was not unusual in the corporate landscape. For example, just in the satellite field, in the 1970s, IBM created as a subsidiary the Satellite Business Systems corporation, which also was formed to benefit the parent company through the same flow of funds from its start-up.[34] Though not uncommon, then, such arrangements built in a critical conflict of interest between the parent company and investors as to whether the parent saw the subsidiary primarily as a source of contracts and manufacturing profit or as an entity whose own distinct business aims took precedence. This was an issue that dogged Iridium throughout the 1990s, a fissure in the project's "united nations" unity that became especially acute as commercial service started in 1998 and faltered in the months thereafter.

Whether Iridium was to be an infrastructure utility only or was to include a robust retail element became entangled in the political and economic transitions of the period. If the venture was to be a utility, the most likely entity to purchase the capability and serve as the customer front was Inmarsat, the very emblem of state-centric political economy. Inmarsat already possessed legal approval in many countries to provide telecommunications services (but not in the Iridium spectrum) and had a network of commercial purveyors. For Iridium, selling the capacity of the satellite constellation to the maritime treaty organization would substantially simplify its business plan. Through the next two years Motorola discussed with Inmarsat this very possibility. But the ideological tides ran in the other direction. Though Inmarsat entertained the idea, it also looked to broaden *its* reach and redefine its technological offering—to join the market turn and compete with Iridium and the other companies in creating a global telephony service. The question then became how such a state-to-market transformation might occur, with what understandings and legal redefinitions. As Inmarsat began to float this possibility, calling their effort "Project 21," Motorola shifted from seeing Inmarsat as a potential partner to a competitor—but one endowed, as noted above by Robert Kinzie, with the advantages of an international treaty organization. From roughly 1992 through 1996, Motorola pushed in regulatory and political circles (primarily in the FCC, the State Department, and Congress) to ensure that the Inmarsat effort would be required to take shape as a private, not state-sanctioned, initiative.[35] By the time Project 21 achieved this redefinition in 1997, Iridium and Globalstar were well along their business trajectory.

Such maneuvering is tedious in its retelling—but this sample of bureaucratic and political infighting was indicative of the numerous small acts undertaken to institutionalize and legitimate market structures in areas previously defined by state prerogative. The PPM, though, did not stake the Iridium business on collaboration with Inmarsat; the business plan, in its structure and presentation of risks, presumed that the likely way forward was to take on the full complexity of a retail enterprise. But the Inmarsat idea signaled the challenges and the ideal of recruiting into the venture those with the right experience and expertise. If not Inmarsat, then the preferred path (and indeed strong initial presumption of Motorola) was to solicit as investors telecom companies, including those with some foothold in cellular. The first candidates included Bell Canada, British Telecom (one of the first PTTs to go private, in 1984), France Telecom, STET (the Italian telecommunications entity), and Nippon Telephone & Telegraph (Japan).[36] Such assessment reflected the obvious relevance of such experience, but also Iridium's core logic: that satellite service was a complement to and extension of land lines and cellular. Though more will be said below on the process of courting investors, this logic placed emphasis on analyzing and justifying the market. In the PPM, another significant aspect of the presentation pertained to characterizing the market—its primary user segments and the expected uptake in each. Through 1997, this issue continually surfaced as the company sought funds from equity investors, the bond market, bank loan facilities, and the stock market. During these years, Motorola and Iridium paid for as many as 20 such studies, reflecting the novelty of the market, the changing landscape of land-based cellular, and the rising costs of readying the system for operation.[37]

In the PPM, the market forecasts oscillated between the cautious and the optimistic. Prospective investors had to make a judgment on a "market forecast [that] was prepared without directly comparable market data" and which derived from Motorola's "considerable experience with existing terrestrial cellular and paging systems."[38] This was the same line of thinking that had led Durrell Hillis to conceptualize the key scenario for the system as a business traveler seeking to phone the office after deplaning at a developing world airport. According to the PPM, Motorola did consult a spectrum of telecommunications providers to complement its own assessment. The expectations were bullish: 1,800,000 subscribers in 2001 (most of which represented acquiring 6 percent of the well-heeled traveler market) and a return on investment of 35 percent. As a broad characterization of usage and global flows, Motorola forecasted that subscribers "in developed countries . . . [would] use their Iridium units for travel in, or for business

in, developing countries [therefore] usage in developed countries is expected to be lower and usage in developing countries is expected to be higher."[39] A deeper analysis of users in the PPM reflected this broad presumption, organized along one axis by category of users and geographic region on the other.[40] The categories included high income, business travel, marine, aeronautical, industrial, government, and rural. Of the total number of estimated users more than two-thirds (about 1,260,000) fell into "high income" and "business traveler"; a little less than one-third would be "government"—these three categories thus composing the great bulk of subscribers. Of those in the first two groups, the vast majority would be from the United States and Western Europe. Expected "government" users, though, were almost uniformly spread among regions of the world. The "rural" segment, a sliver of the overall estimate, would consist of users "primarily in emerging and developing countries," drawn from the estimated "two billion people worldwide [that] have no access to convenient telephone service."[41] Of these few users that might access Iridium, more than half were projected to come from "the USSR, Brazil, India, and the People's Republic of China." Yet such users, potentially vast in number, lacked wherewithal to purchase the service except through government subsidy, and thus were barely a ripple in the business plan. In a way not intended the PPM's analysis of users and places offered a mirror of the global world—its disparities in power and resources, of the lingering geographic dynamics of pre–World War II colonialism, of flows of capital, of the movement of elites, of the immobility of billions. It mirrored, too, the special ideological status of the boom and expansion of communications technologies, in which communications could be seen both as lubricant for the existing political-economic order and as a means to enable the "general elevation of the population" in developing countries (as the US planning report for WARC had put it).

The PPM was the combined product of Goldman Sachs, Motorola engineers, and Motorola corporate. Soon after its completion in September 1991, some of the Iridium principals, led by Bill English and Leo Mondale, pushed for the formation of a "strategic planning group" to address what they saw as shortcomings in the PPM and to manage the politics of getting Iridium under way. Three central criticisms of the PPM emerged. One pertained to the key question of the market for Iridium service, especially as to the projections for the "high income" and "business travel" segments that were the foundation of the business plan. The group noted that "there needs to be a more comprehensive analysis of other competitors, worldwide, and their potential, or lack thereof, in each of these major market segments, otherwise the forecast lacks credibility."[42] Another was

the structure of the contract by which investor money would flow to Motorola to build the system; the last concerned the rights and benefits conveyed to investors for operating the system's gateways, those links between the space constellation and terrestrial networks that would provide the primary operating revenues. All the critiques pointed to how Motorola had not fully laid out or assessed the context in which investors might commit to the project—either as to the characterization of the market, in the terms of the key contracts, or in making the gateways viable business entities. The PPM thus, whether advertently or because of the formative, rushed nature of the effort, protected (and highlighted) Motorola's interest as a supplier of hardware more than it sought to facilitate the creation of a multi-partner global enterprise.

The PPM did get revised, with another iteration in 1993 that addressed such issues, but the first cut captured that distinctive tension at the heart of the enterprise: was the idea of the global in the venture defined by the interests of a traditional multinational corporation or by a different concept of the corporate, a multinational partnership?

These conceptions, of course, overlapped. The strategic planning committee sought to balance such tension between founder and investor motivations, but focused more on the problem of positioning Iridium in the broader landscape—of competing companies, of regulators, of media narratives of the global. In the "battle of the ink" it sought to "position Iridium as the privatized force of progress and competitiveness against the forces of the other side."[43] The group thus sought to recalibrate Motorola's positions so as to better manage this larger competitive struggle. The "forces of the other side" were the several competing companies that though presenting themselves as entrants in the global communications business did not provide truly global coverage or had not presented business plans (however flawed) to the FCC in support of their technical concepts. The "other side" also and especially included Inmarsat and Intelsat, which were seeking to straddle their legally protected status as international treaty organizations and the lure of profits in the regime of private markets. The group's aim was to make clear Iridium's superior offering, technically and as a business concept—and as a vanguard of a privatizing world.

At the same time that Motorola pursued discussions with Inmarsat to collaborate, the planners prepared to counter the maritime group's exploratory entry into mobile telephony market, arguing that "Project 21 is a study concept, not a program for establishment of a system," and that "Inmarsat has neither the authority under its intergovernmental charter nor the allocated funds to move

ahead with a program."[44] In October 1991, Motorola and Lockheed put together a glossy tutorial of low Earth orbit and geostationary communications, comparing each of the competitors—a presentation aimed at knocking down any potential support, especially for the state-centric Inmarsat, in the media and among political decision-makers in the US government.[45] This constituted a strategy, as the group stated it, of "creatively slipping through" the challenges posed by Inmarsat and Intelsat.[46] Motorola did not have to pursue this strategy alone. As a signatory to Inmarsat, the US government had leverage in shaping that organization's policy. Under the banner of the Washington Consensus, it, too, had a stake in helping Motorola navigate the changing boundaries between private and public entities and advance the ideological push toward privatization, thereby promoting the international interests of a US corporation and a new business sector—and it did so through the next several years.

But the crosscurrents of the global connecting Motorola, the US government, and other international players brought forward other complexities. As a US-chartered corporation, Iridium, by law, had a key limitation for an entity with global aspirations: non-US ownership could not exceed 49 percent. In taking the corporate rather than a different organizational form Iridium would incur greater tax liability, losing the advantage of writing off "early year substantial losses." Though US governmental entities provided a resource to support Motorola and Iridium interests, they also could bind corporate prerogatives: "regulatory jurisdiction of FCC and other US agencies is pervasive and will extend to all operations of the company, not just the US investors."[47] The corporate form, in a sense, reflected an earlier conception of nation-state and market, not yet fully adapted to the early 1990s global moment. Indeed, once investors came into the venture Iridium changed its form to a limited liability corporation (a form of partnership) and moved its country of incorporation to the Bahamas. This type of entity itself was a marker of period globalization, only gaining broad legal acceptance in the early 1990s for its greater flexibility in managing the finances of a transnational enterprise.[48]

Motorola's standing and prior history with government programs, especially in black programs, could create complexities, too. Apparently in the fall of 1990, the renowned physicist Edward Teller and the physicist Greg Canavan (then at Los Alamos National Laboratory) approached Motorola on the possibility of "using the Iridium constellation as an earth sensing platform," reasoning that "given Iridium's simultaneous view of the entire earth, data . . . which had not previously been available [now] could be." Their purpose was not clear, whether

such request to deploy infrared sensors fit into Livermore's national security or sometimes civilian work, but they offered the instruments could provide data on "storm formation, real time crop assessment, etc." Their proposal to piggyback on the satellite constellation was not the only one. A coalition of universities also asked to place a sensor on the system's satellites for earth science studies on the ionosphere. In September 1991, Motorola convened both groups "to make detailed presentations on their sensor packages." At the meeting the astrophysicist Lowell Wood, at Lawrence Livermore National Laboratory and well known for his support of the Strategic Defense Initiative, reinforced the appeal of Teller and Canavan. According to Iridium's notes of the meeting, Lowell indicated that "there would be considerable political support for the system if such [infrared] sensors were included," but the "promised details of this support and how it might help us at the FCC did not materialize."[49]

Then just after the meeting with Wood, James Frelk, director of the Office of Space Commerce, Department of Commerce, approached Motorola to make a similar request, but with a different motivation: Vice President Dan Quayle was in favor of "private enterprise taking over the Landsat mission of NASA and that Iridium could prove Quayle right in his claim that the new $300M Landsat satellite NASA is requesting is not necessary. He indicated that if Iridium was to add such a sensor capability the FCC would surely support the system." After these meetings, Eastman Kodak, long affiliated with intelligence programs, had scheduled a visit "to discuss leasing space and lines on Iridium to collect and distribute sensor data."[50] These various requests from well-connected political actors led Motorola and the strategic planning group to give this idea serious consideration. The latter group decided to include the possibility as a potential rhetorical advantage in its effort to pitch the new venture, with its positives as "may provide information of value to man" and "may result in support for worldwide MSS allocation."[51] But the engineering risks were perceived as too great; not least, the Iridium board likely would react negatively to US government involvement. None of the proposals were developed.

All these various discussions highlighted the shifting and muddy character of the state-market boundary, in fact and rhetorically, as it played out across a spectrum of governmental agencies and their distinct interests. As indicated by the actors, the stakes were high, tugging between the powerful political leverage of defense elites and the enhanced emphasis on markets in top-level policy. Such requests forced Motorola to sort through how to respect its old government alliances, yet move forward with its global market ambitions, especially so as to cre-

ate a framework that engendered trust among non-US investors. To make the satellite constellation an extension of the US defense and intelligence establishment just as Motorola was courting Russia and China to join the project ran against the grain of the venture as an emblem of a new, transnational market world.

In the fall of 1991, as WARC loomed, the strategic planning group focused on clarifying Iridium's core messages, as a proactive measure to draw investors and as a way to deflect expected critiques from their corporate competitors and the FCC. These clustered around three ideas at the heart of the enterprise since its inception: "global handheld telecom," "mastering the trend toward mobility," and "profiting from liberalization." The PPM was a thick, detailed document, with detailed appendices; it needed a simplifying narrative for "our entire industrial-corporate-investor-marketing team to see the 'forest from the trees.'" That simplifying narrative took the form of a graphic (fig. 3.1) of three nested

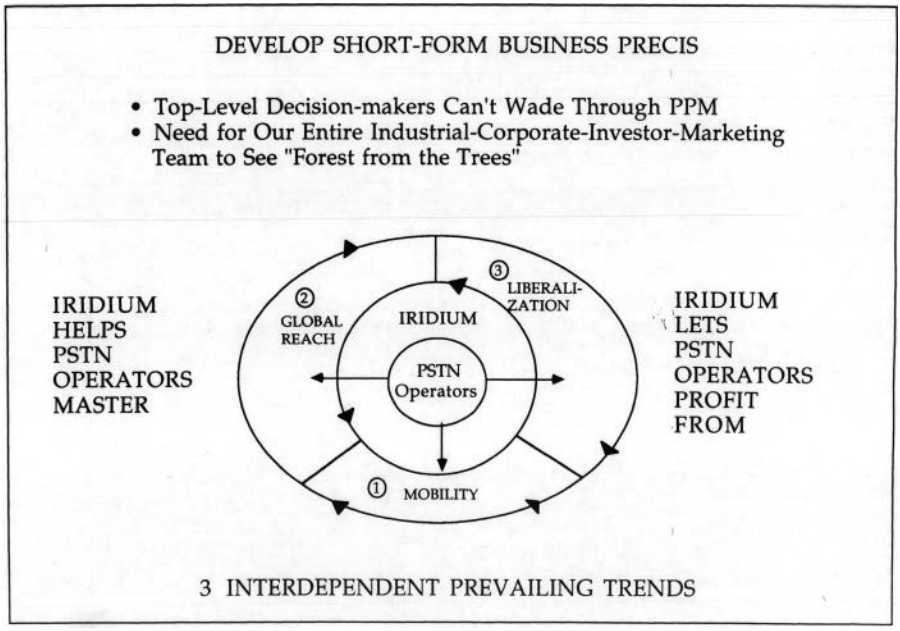
DEVELOP SHORT-FORM BUSINESS PRECIS
• Top-Level Decision-makers Can't Wade Through PPM
• Need for Our Entire Industrial-Corporate-Investor-Marketing Team to See "Forest from the Trees"
IRIDIUM HELPS PSTN OPERATORS MASTER
② GLOBAL REACH
③ LIBERALI-ZATION
IRIDIUM
PSTN Operators
① MOBILITY
IRIDIUM LETS PSTN OPERATORS PROFIT FROM
3 INTERDEPENDENT PREVAILING TRENDS

Figure 3.1 This graphic sought to highlight for potential investors and telecommunications regulators around the globe the ways in which Iridium would help them see the "forest from the trees" in the new political-economic landscape of the early 1990s. As exemplar of this new era, Iridium would help them "master" and "profit from" the trends toward global reach, economic liberalization, and increased demand for mobile technologies. William English, Oral History Working File

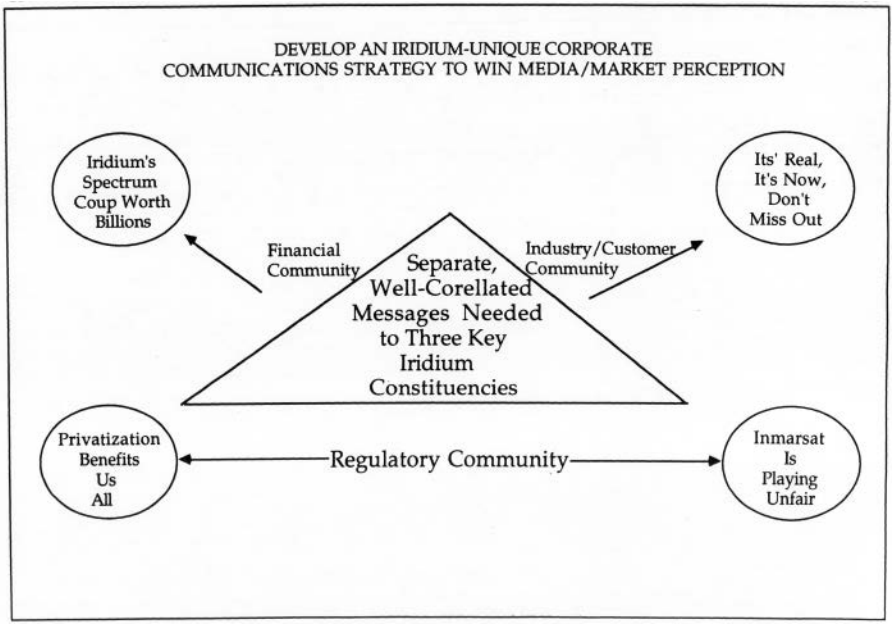
DEVELOP AN IRIDIUM-UNIQUE CORPORATE
COMMUNICATIONS STRATEGY TO WIN MEDIA/MARKET PERCEPTION
Iridium's Spectrum Coup Worth Billions
Its' Real, It's Now, Don't Miss Out
Financial Community
Industry/Customer Community
Separate, Well-Corellated Messages Needed to Three Key Iridium Constituencies
Privatization Benefits Us All
Regulatory Community
Inmarsat Is Playing Unfair

Figure 3.2 In pitching a product that would not be realized for several years, Iridium needed to shape the perception of its effort with the financial community, potential customers, and telecommunications regulators in the United States and elsewhere. This messaging combined braggadocio ("spectrum coup worth billions") with grievance ("Inmarsat is playing unfair") and the period's enthusiasm for the market ("privatization benefits us all" and "it's real, it's now, don't miss out"). William English, Oral History Working File

concentric ovals. The state-owned PTTs (referenced here by their alternate designation, public switched telephone networks or PSTNs) occupied the center, with Iridium enveloping them, and then the context of global reach, mobility, and liberalization surrounding both. Iridium thus was to be a mediator between the old world of state-organized communications and the border-hopping global world of the 1990s. Iridium would help the PSTNs "master" and" profit" from these "interdependent prevailing trends." For the group, such characterization solidified the way to address Iridium's several, primary constituencies (fig. 3.2). For the industrial and customer communities, such rhetoric was to say "it's real, it's now, don't miss out." For the regulatory community, in the United States and internationally, it touted "privatization benefits us all" and as corollary the state-blessed Inmarsat "is playing unfair" in using its position to compete with private firms. And with prospects looking good for securing spectrum at WARC, the

message to the financial and investor community was "Iridium's spectrum coup worth billions."[52]

As Motorola and Iridium went to WARC in February 1992 they had in tow this complex of issues and associations—ranging from details of contract terms and corporate law to the multifaceted messiness of implementing neoliberal policy in national and international forums. To this point, most of Motorola and Iridium's focus was on establishing the bona fides of the venture in the United States. WARC shifted that focus, pushing the US corporate conception of the global squarely into the international arena. It would bring to the fore the relation of the venture to the history of colonialism, its lines of force still prominent in the geopolitics of the early 1990s, and of its relation to the collapse of the Soviet Bloc. As the earlier discussion of the Washington Consensus suggests, also entangled in these relations was the US government, the dominant actor on the world stage, giving Motorola and Iridium imprimatur to serve as proxies for US interests. WARC—then the push to acquire investors for Iridium—stood as a test of the way in which neoliberal ideology might inform and shape the global.

World Administrative Radio Conference, 1992

The ITU originated in the mid-nineteenth century to address the nation-spanning challenges of communications by telegraph. In the post–World War II period, it was folded into the newly created United Nations, placing the organization not only in the context of First and Second World Cold War geopolitics but also in the intersecting context of decolonization.[53] The tens of new nations that were constituted in the postwar years entered the framework of ITU decision-making, the most critical element of which was the consensual allocation of radio spectrum internationally. As already described in the Iridium case, though such decision-making focused on creating a coordinated regime for international communication, it also affected national schemas of regulation—they were an interlocking system. But, of course, not every nation or grouping of nations entered this arena of decision-making on equal footing. As with other vectors of geopolitical power, the United States had significant clout, as did the European nations and the Soviet Bloc, to marshal support for their preferred positions on spectrum allocation.[54] But such disparities in power were counterbalanced by the ITU decision-making process: each country had one vote and allocations required consensus agreement. This provided leverage for the new (mostly Third World) nations in dealing with the less numerous, more powerful Western nations. With the history of colonialism still a tangible presence, this process estab-

lished a dynamic in which First and Third World interests were contested and found accommodation. It was through WARC, held roughly every three to five years, that this tangle of geopolitics, history, and negotiations of power was most acutely engaged: at any given conference final, consensus decisions on spectrum allocation and use had the force of an international treaty. This fact intensified the stakes of each gathering, turning slices of spectrum into valuable, protected resources for those positioned to exploit or control them, whether government or commercial entities.

After the 1957 launch of *Sputnik*, WARCs periodically gave special attention to the question of space-based communications, the first instance of which occurred in 1962. Its guiding perspective tracked that of the United Nations as its parent contemplated the development of spaceflight capabilities: that "exploration and use of outer space should be only for the betterment of mankind and to the benefit of States irrespective of the stage of their economic or scientific development."[55] This principle underpinned the establishment of Intelsat in 1964 and subsequently that of Inmarsat. In the 1970s and 1980s, space-themed WARCs focused primarily on communications through geostationary satellites—the bread and butter of Intelsat and Inmarsat. These two entities as UN-organized international treaty organizations had as their very purpose to ameliorate and reverse the history of colonialism, but to do so through state-to-state engagement—a mirror of the modus operandi of the United Nations. Developed and developing nations were members, sharing an overlapping interest in creating a transnational communications infrastructure that served both as an instrument of Western state and business ambitions and as a potential means of self-definition and modernization for the Third World.

As a series of WARCs considered satellite communications in the period before the late 1980s, the organizing assumptions of Intelsat and Inmarsat helped to diffuse the inherent economic and political tensions of building and operating a transnational system—to at least address if not actually moderate the disparities of power between the First and Third Worlds. WARCs then were more about confirming accommodations worked out in the context of day-to-day administration and operations through Intelsat and Inmarsat than about resolving pent-up geopolitical tensions every several years. But within this paradigm, beginning in the 1970s, two vectors of change began to emerge. One centered on individual nations (and some regions such as the Middle East) seeking to develop satellite communications for their specific state interests, a prominent part of which, again, reflected the efforts of Third World countries to overcome

colonial legacies. The other vector came from the corporate world, which with the rising status of neoliberal ideology, sought to break down the favored position and advantages held by Intelsat as a treaty organization. WARC 1987 (the one just prior to WARC 1992) took up for the first time corporate-originated proposals for spectrum. These were from US firms (supported by the official US delegation to WARC) and the first foray into providing satellite-based mobile services, primarily aimed at creating a global market for RDSS. Notably, all of these initiatives came from small start-up companies, not from major corporations. In just two years the Cold War ended, coinciding with the clear ascendance of the neoliberal turn to deregulation and privatization—the Washington Consensus outlined previously. With that turn, the role of markets and corporations—Fortune 500 corporations such as Motorola—reconfigured the underlying geopolitical dynamics of WARC as a venue from negotiating state-to-state interests to states as mediators of corporate interests.

This background dovetailed with the preparations Motorola and Iridium made through late 1990 and 1991 to secure globally approved spectrum at WARC 92. Held in Malaga-Torremolinos, Spain, a coastal city on the Mediterranean, during four weeks from early February to early March, with a cast of several thousand, the conference was a bureaucratic convocation, defined by an elaborate structure of committees and processes to arrive at a consensus agreement on a multitude of proposals for spectrum allocation and use. More than 1,400 official delegates, designated by their respective governments, from 127 countries participated. The US delegation was led by Ambassador Jan Witold Baran (who at the time also was serving as general counsel to the Republican National Committee), with a supporting cast of about 50, composed of individuals from the FCC, the State Department, and the Commerce Department as well as selective representation from industry, including Motorola. But this mass of officialdom had a complement: an even larger number of non-delegate participants, primarily corporate representatives seeking to persuade delegates to take positions favorable to their interests. Motorola and Iridium had as many as 100 people at the conference in support of their issues.[56] Though non-delegates were not supposed to intervene in the process of decision-making, as a practical matter they did, a natural outcome of elevating market values, deregulation, and privatization as the path to a better future for international telecommunications. The participants recognized this WARC as a flexion point, in which neoliberal values supplanted those of traditional nation-state diplomacy, bringing in as a greater presence corporate promotion and lobbying. The result was a complicated mixing of official work

and extra-conference maneuvering for votes, with final decisions having the force of an international treaty.

Though the US delegation took as its primary objective Iridium's call (as well as that of the other Big LEOs [low Earth orbits]) for spectrum, if Iridium was to acquire its allocation it would need to help organize support for this official position through the broader informal free-for-all surrounding the conference. As the pre-conference planning report noted, the landscape of policy-setting had changed, claiming that the United States "is in danger of losing its market-based power and with it, some of the enormous influence this country has enjoyed in international radiocommunications policymaking. The Europeans, for example, have shown an increasing unwillingness to follow the US lead in international spectrum policy."[57] WARC, for the leaders of the US delegation, was about protecting US power over international policymaking, the key means for which was to promote US-based technology and firms: "Without the new services made available by the new radio-based technologies, the US position as market leader could slip further, siphoning off business and innovation to countries with more flexible radiocommunication environments."[58] US state interests thus fundamentally overlapped with Motorola's objectives for Iridium—then the most dramatic statement of communications' future possibilities.

But the question at WARC was primarily one of tactics, in particular (as the quote above noted), on how to respond to the increasing independence of Europe in setting its own interests, often different from those of the United States.[59] Under the egalitarian "one country, one vote" standard of the ITU, the United States had to contend with a newly, unified bloc of 31 European countries (the Conference of European Postal and Telecommunications [CEPT] administrations) that in the 1980s began to "formulate strong regional positions that were strictly adhered to at international conferences."[60] The tactic pursued by the United States, Motorola, and Iridium was to court the support of countries from the Middle East, Africa, Latin America, and South America—both because the "numbers" were in these regions but also because of European reluctance to align actively against the preferred policy position of former colonies. The challenge for the United States and Motorola was to convince such countries to be supportive of their position. Their argument hinged on a line of thinking reminiscent of modernization theory: that the satellite constellation would provide an instant infrastructure for communications where none or little existed, providing the possibility of connecting those three billion individuals without service in the Third World to their nation, region, and the larger world. Such arguments were embedded in Intelsat

as well, but with Iridium the promise was for individual-to-individual mobile communications rather than state-to-state communications linkages—in short, to be closer to the vanguard of communications developments. The obvious rejoinder, though, was to ask how each country might directly benefit, monetarily and socially, if it lent support to Iridium at WARC. This was a key question in the push toward deregulation and privatization. Intelsat had been set up to support national PTTs and provide a significant stream of local revenue; with Iridium, it was unclear whether it would augment that model or more likely undermine it without a compensating flow of income.

Through the course of the four-week conference the formal process of discussion and position-taking interwove with lobbying. The conference had a hierarchical structure composed of occasional plenaries, major committees such as "allocation" and "regulatory," and a bevy of subcommittees such as "broadcasting" and "satellites" that dealt with the fine-grain of issues. The multiple agenda items, developed at pre-conferences, were dispersed down through the committees, at which the different national delegates read out their respective policy positions as well as responses to other national positions. As Martin Rothblatt recalled, delegates might say, "'Our country believes frequencies should be given to Iridium,' or 'should not be given to Iridium' . . . so the U.S. sent its proposals on Iridium to every country in the world. Russia sent its proposals on some shortwave modifications they wanted to make to every country in the world. So they come to the meeting with all the different countries' proposals, and their own government's view, in terms of 'We like this. We don't like that.' "[61]

As agreements were reached at the subcommittee level they would be sent up the chain to be voted on at a plenary. Proposals for which there was broad agreement or minimal opposition would get settled early in the conference, more difficult proposals at the very end. The work of the delegates, as Rothblatt noted, was "going on morning to night, late into the night, even. In parallel with this there's five times as many non-delegates, private-sector people, who are all over the conference hall, and every time delegates walk outside, they pull them aside and say, you know, 'I'd really like to point out the benefit of such-and-such a thing,' and so there's all of these lobbyists, in essence, who are outside trying to identify which countries are, like, against them and turn those countries toward them, toward the view that the private interest has. And this is all with the blessing of the country of the private interest, because it's making their job much easier."[62] For the US delegation, as with all delegations, this extracurricular process could help with its main objective: get US proposals approved. "And they

love it, to have the private-sector people helping them, because they can't, you know, single-handedly hit a hundred countries, but having hoards of Motorola people going around telling [them], 'Hey, we got Lithuania on our side.' [They would respond] 'oh, that's great. They're in the drafting group on this issue.'" As a complement to this ferment, corporations would "every night [put on] stupendous parties and splashes, some of them extremely extravagant . . . every night, all of these delegates and all the observers, hangers-on kind of people, all converge on—they're all pretty much, essentially, open parties—and spend three or four hours boozing it up, eating little, you know, hors d'oeuvres and whatnot, and continuing the process of turning people to their side."

Many of the Iridium principals came to WARC: Ray Leopold, Durrell Hillis, and others from the Government Engineering Group in Phoenix; Motorola corporate leadership, including John Mitchell; and, of course, the small core group of Iridium, Bob Kinzie, Jerry Adams, and Leo Mondale. For the engineers and the Iridium leadership this was their first WARC, formal and fluid as an event, expressive of the changed and changing contours of geopolitics—and fundamental to the future of the venture. The issue of spectrum for Iridium (and all the Big LEOs) was one of the most contentious—for its contrast with the interests of Intelsat and Inmarsat, the increased confrontation with Europe on a range of telecommunications issues, and the uncertainty of Third World countries as to the value to them of these private constellations.

Just prior to WARC, Iridium prepared responses to likely questions that might come in media interviews, with "What benefits will Iridium provide to developing countries?" as one query. The answer focused on two issues, revenue and sovereignty: "developing countries will receive hard currency from foreign users . . . with which they will be able to subsidize local uses of Iridium [such as] emergency and disaster relief services, government officials on travel, border guards and rural telephone booths, etc." Moreover, all Iridium calls would pass through a nation's own PTT, ensuring both maximum revenue and state control over Iridium's use within national territory.[63] This response, with its calculus of "win-win," stood as a near perfect mirroring of post–World War II modernization projects. In subsequent years, such financial consideration was bundled together with another way to enhance developing countries' self-sufficiency through Iridium: as a solution to "emergency and disaster relief services." This was a constant motif in these kind of presentations by Kinzie and others—a not untrue statement but one that in its framing expressed a lingering paternalism toward Third World nations.

At WARC and subsequently, the assumption was that foreign economic in-

puts would fulfill or contribute to fulfilling core needs of individual developing nations. In contrast with modernization projects in the 1950s and 1960s, the difference now was that 1990s modernization strategy, grappling (still) with obvious imbalances of power, was shifting to the auspices of the market, aided by state-sponsored institutions such as the World Bank and the International Monetary Fund (IMF). Iridium was emblematic of such thinking throughout 1990s, especially as it sought governmental approvals for the effort. In 1994, in seeking to finalize FCC support, Motorola offered that "unlike geostationary systems, which concentrate coverage on their target markets within a limited footprint, LEO MSS systems will offer the same capacity and quality of service to developing countries as to the industrial world, including the people living in the rain forest, the vast deserts and steppes, and the polar regions."[64] To implement a fully global market regime was to make possible a political economic condition that would, at last, empower developing world peoples literally everywhere. But, too, Motorola, later in the report, noted that "lack of a telecommunications infrastructure is one of the most important disincentives to US companies from investing in developing countries," and that Iridium and similar systems "can reduce this concern and change the cost-benefit tradeoffs in the calculus of U.S. corporations."[65]

At WARC, Iridium also generated wrangles with other users of nearby spectrum, particularly radio astronomers and the Russian GLONASS system (Russia's equivalent to the US GPS). Adding to these challenges was the confusion in ex-Soviet Bloc countries as to the wherewithal of their delegates to enter into binding agreements. Not least was the very idea of granting privately controlled spectrum on a planetary rather than a national or regional scale. There was, in short, a mix of political, conceptual, and technical issues that needed to be directed in Iridium's favor through persuasion and trading "I will support you on this, if you will me on that" tactics.

The apparent fulcrum in aligning support was the chair of the Morocco delegation, Abderrazak Berrada. Educated as an engineer in Paris and serving as the chair of ITU's International Frequency Registration Board since 1965, he was considered the leading authority on telecommunications matters by countries in the Middle East and Africa. Although the reasons are unclear, he decided to support the US delegation and Motorola's position on Iridium, persuading countries from these two regions (not infrequently antagonistic to US interests at prior WARCs) to support the Big LEOs as well as maneuvering the Europeans to drop their resistance. A complementary factor came through Martin Rothblatt and his associate Noah Samara, a native Ethiopian, both of whom were seeking to gain

spectrum for satellite-based radio service in the United States, Africa, and Asia. Samara and the US delegation made an arrangement in which he would promote the mobile telephony satellite constellations to African countries and the United States would not oppose the satellite radio initiative. Samara and Berrada's effectiveness, in part, and especially in the case of the latter, derived from the limited expertise in many of these countries to assess the ambitious US proposal and its consequences—they were trusted mediators. Incentive, too, came from Motorola. As a multinational corporation, with a variety of telecommunications interests from cell phones to infrastructure to military hardware, it undoubtedly offered tangible inducements in these other business areas to reluctant countries. But the underlying issue, against the still pervasive legacy of colonialism and its aftermath, was trust—Berrada and Samara provided it in sufficient measure to bring Iridium to the verge of success.[66]

As one of the conference's most contentious issues, the vote on whether or not Iridium would gain its spectrum came down to the final plenary, a marathon 24-hour review and vote on the numerous proposals. Walda Roseman, head of the International Office at the FCC and vice chair of the US delegation, saw the moment as a critical repositioning of the United States' leverage in international telecommunications: "the maneuvering was extraordinary. It was high, high tension. The U.S. knew it was going to have to trust Berrada on this one to make it happen, and this was a very new experience for the United States—because the [United States] had gotten into a mode where the *we-they* was us, the U.S. and Europe, and *they*, the developing countries. We went in with a deliberate strategy to make *we* the U.S. and the developing countries, and as many of the developed countries as we could, but that the *they* was clearly going to be the block-European vote."[67] The vote was a "cliffhanger," coming near the very end of the session, with delegates falling asleep at their desks in the main conference hall. The proposal for the Big LEOs was read and the chair asked if there were any objections; none were raised, as many of those who had stood in opposition were absent or asleep. Motorola and Iridium won their spectrum through a messy alliance with Third World countries and the fluke circumstance of a late-night vote. It reflected the historical moment's brew of power disparities, geopolitical realignments, the turn to the market, and the (continuing) attempt of developing countries to assert their interests. It highlighted, too, now that the valuable resource of a global spectrum allocation was in hand, the challenges the venture would face in raising capital and creating a business plan that could navigate the tensions of North and South, West and East.

Fitting Iridium into the 1990s Global

The experience at WARC 92 revealed many of the specific issues and features of the 1990s that were shaping a US corporate-led global, animated by neoliberal ideology and its relevance to geopolitical action. One crucial vector was the interdependent and overlapping interests of the US government (broadly across multiple departments and Congress) and US multinationals. Motorola and Iridium fit squarely into this matrix, but added something of special importance: the perceived status of telecommunications as the critical means for facilitating political freedom and economic uplift (a major emphasis of the OTA report prepared for WARC). The conference highlighted the power of this government-corporate collaboration, but also its substantive limits as Europe redefined its economic interests independently from the United States, as the countries of the former Soviet Bloc sought political definition and developing countries pushed for greater geopolitical equity. To implement this US global, Motorola and Iridium needed, just as at WARC, the buy-in, in some measure, of these non-US actors. Thus, as the Iridium principals pivoted from the success of WARC, the development of the business was shaped fundamentally by this engagement between the global as envisioned by the US government and Motorola and these many locals, each with distinctive national or regional conditions and interests. As with WARC, too, this was not a matter of imposition. In a market context, especially, these relationships were partnerships, but not the kind in which all the partners possessed equal power. Motorola, through its standing as a leading, deep-pocketed US technology firm, in its de facto alignment with US policy, and, of course as originator of the venture, was the dominant presence.

In concept, this dynamic is closely aligned with Geir Lundestad's thesis about US geopolitical power captured by his phrase "empire by invitation," a characterization that he saw as especially applying to US-European relations in the first years after World War II. But he also offered it as descriptive of the role of US power throughout the twentieth century. The "invitation" came either tacitly or explicitly from those that saw the presence of US power as in their national interest. In the context of the early 1990s, the US commitment to the Washington Consensus, and Iridium as a global venture, such an "invitation" occurred through market-based and legal negotiation among Motorola, potential non-US investors, and national governments. Even when investors felt leeriness at Motorola's intentions, its perceived corporate power and its alignment with US state interests proved potent. Iridium as a project, at the vanguard of a global transfor-

mation in communications, seemed a critical means by which to participate in US power and technological innovation in service of one's own interests.[68]

This balancing between global and local, between Motorola and other investors, played out through a series of steps that defined Iridium, structurally and conceptually. The two most significant were the tasks of securing investors from different regions of the world and then having these investors establish the gateways that would connect the satellite constellation to the traditional switched telephone system and cellular networks in various regions of the world. A central part of signing on as an investor was to take on as obligation the creation of a gateway as a separate business that would conform to Iridium's business goals; each gateway, in essence, was a franchise. The gateways thus were a patchwork of "locals" that, in theory, would deal with the distinctive business and political conditions in their domain of operation, which then fed back into the "global" purpose of Iridium the business. Each gateway, as a business goal, had to arrange for service providers to sell the Iridium service, as well as agreements with cellular providers to arrange for "roaming" between Iridium and cellular networks. Each gateway, as a political matter, had to get national approval for use of the WARC-approved spectrum—just as Iridium had to do with the FCC. For these tasks, the presumption was that a local (or at least regional) entity was significantly better positioned to facilitate the necessary business and political actions. Once the system was operational, all of this was a preamble and supportive of the main task: to acquire customers willing to pay the cost of an Iridium phone and/or pager as well as airtime charges.[69] This structure, this specific conjoining of local and global, had as a critical feature a traditional organizational trapping of a corporation: a board of directors. Investment in the venture, in addition to acquiring a gateway, earned a seat on the board and thus participation in the management of the company. It was this feature that in 1998 enamored *WIRED* magazine and led to its effusive characterization of Iridium as the emblem of a new era of pan-national corporations.

What made the effort distinctive was not its textbook business structure but its particular marriage of the local and the global. Embedded in this framework was Motorola's dominant position in the venture—as originator of the idea, by virtue of its already sizable expenditure of funds and by its positioning as holder of the critical technical expertise and as designated producer of the entire system: satellites, gateways, and phones. This disparity among the partners was only reinforced in the investment stage as Motorola held the largest ownership share of the venture (declining over time from more than 50 percent to 18 percent,

even then more than any other investor). As the venture matured through the 1990s, with investors assembled, the tensions built into this arrangement grew more pronounced, separating Motorola's interests from those of its financial partners. Adding to such tension was an issue that had not been fully assessed as, post-WARC, Motorola sought partners: could the several locals, especially from less-developed countries, that invested in Iridium effectively fulfill the business mandate expected of a gateway owner and operator? As evidenced by *WIRED*'s "united nations" gloss on the project, Iridium carried an image of beneficial collaboration. Yet, structurally, the venture held deep tensions that were both inherent in the 1990s global and proved fundamental to the venture's eventual collapse.[70]

As Motorola and the core Iridium staff sought investors after WARC they had several guiding assumptions. Foremost was that the on-the-ground service would be available globally, mirroring the technical capability of the satellite constellation. This stood in contrast with their primary competitor, Globalstar, which focused on service to the most-populated regions between the mid-latitudes, north and south. This meant that the venture needed investors who could fulfill this objective and thus were distributed geographically, covering the major regions of the world. This desideratum led to one of the colorful, pell-mell, time-is-of-the-essence undertakings of the venture—of the Motorola and Iridium principals embarking on a frantic transnational quest for investors. Investors not only had to be acquired, they had to be acquired as quickly as possible to sustain the credibility of the project. Durrell Hillis, Leo Mondale, Ray Leopold, Mark Gercenstein, Bary Bertiger, Bob Kinzie, and John Mitchell spent much of 1992 and 1993 on airplanes, pitching the venture using the core arguments of the PPM as an outline of its potential value—generally a mix of local benefits such as enhancing telecommunications infrastructure to being part of the vanguard in a key area of technology development.[71] For the principals this was an exhilarating if exhausting exercise, moving from the original abstraction of the global to its materialization in equity and a set of investor relations. But the results of this process—never certain of success until the last investor was brought on board—revealed the idiosyncratic, historically grounded nature of composing the global, both as to US geopolitical positioning in the wake of the Cold War and Motorola's specific resources as a multinational corporation.

This can be seen through the lens of another desideratum in raising capital that overlapped with the preceding: to acquire investment from leading telecommunications companies (say, AT&T and its rough equivalents elsewhere),

whether private or state-controlled. This, again, reflected Iridium's awareness that it needed to create an effective interface between its service and potential customers. As the search for capital intensified in 1992 and 1993, the second hoped-for aim did not materialize. Motorola pitched such firms, in the United States and elsewhere. AT&T, for example, saw little upside in relation to its established business, nor did France Telecom, which saw its interests through the lenses of national advantage and of the European position vis-à-vis the United States. Such results left Iridium with a void in a critical area of business expertise. Motorola and Iridium thus had to set their sights on investors less experienced in telecommunications or who had no experience at all but were enamored of Motorola's record of success and had a desire to be part of a US-led, high-technology venture. Many of those who came to invest already had worked with Motorola as partners or customers in other parts of its technology portfolio, especially in Asia, South Asia, South America, and Latin America. Investments from Japan, Korea, Thailand, India, and Taiwan came through such prior business relations; in only the case of Japan was one of the primary investors, DDI, involved in the business of telecommunications service and with a secondary position in the Japanese market. Thus, on a critical issue of how Iridium, once the system was operational, would sell and distribute its offering, the venture was handicapped—many of its investors would be entering the relationship absent the requisite experience. This situation only took on a more problematic cast with the investments from Russia and China. Investments from both were considered essential because of their vast geographical areas as well as the post–Cold War perception of their market potential, then and in the future, as capitalism and quasi-capitalism redefined the breadth of the geopolitical landscape. But in each instance the investing entities were specialists in launch vehicles—Krunichev for Russia, China Great Wall Corporation for China. In neither case were they experienced with telecommunications or with the day-to-day work practices of a corporation defined by Western business values. Other more savvy investors such as Sprint in the United States and Vebacomm, a German cellular firm, joined the fold, but their presence only highlighted the disparity in capability among the investors—a disparity that mirrored historical differences among First, Second, and Third World actors and of Motorola's relations to each through the 1980s and 1990s.[72]

In 1993, Motorola and Iridium lined up the first $800 million in investments and another $800 million in 1994. This infusion of monies triggered the formal execution of two interrelated contracts between Motorola as engineering entity and Iridium as company. One was for Motorola to build the satellite system—

spacecraft, control centers, and tracking and telemetry stations—and get it into Earth orbit. The other was, as the system was being launched, for Motorola to "maintain and operate" the system. Both of these activities had been laid out in the original PPM as part of the offering to investors and now, with funds in hand, their meaning was given full expression. The contracts signaled Motorola's position as the source of technical knowhow, but they also opened a fault line in Iridium as business. Investors other than Motorola now controlled well more than half of the company, a circumstance that brought to the fore the tension between Motorola's interests and those of everyone else as the venture moved forward through the next four years.

This tension manifested itself in a variety of ways in key moments of decision-making, especially as questions of finance, expertise, and business and institutional capabilities of the gateways became entangled. One of the first instances was the execution of another contract in late 1994 and early 1995, the Terrestrial Network Development Contract (TNDC), which provided for building the gateway stations in each investor territory. This, too, as contained in the PPM, was presented as a requirement in joining Iridium—the gateways, after all, implemented a key feature of the system, the linkage of the satellite system with public switched networks, the space-based global with the Earth-based global. But the mechanics of that implementation had not yet been specified. Significantly, the contract and its associated costs were not included as part of what the first two rounds of investment would cover. The gateways through their individual investors had to bear this cost, independently and above their investment in Iridium, and convey those additional funds directly to Motorola, which, not surprisingly, would supply the needed hardware and software. Iridium was not directly involved as the gateways stood as separate businesses. The TNDC and the relations it embodied highlighted the importance of the gateways in Iridium's vision of the global but also its fragile manifestation—the unsteadiness of the gateways' financial and expert capacities; Motorola's seeming exploitation of the gateways as captive customers; and Iridium's institutional structure, which relied on gateway investors but kept the gateways themselves organizationally distinct. Though a seemingly small episode in a longer story, the TNDC captures the messy, contested way the idea of the global was created *in* Iridium, a complement and contrast to the process of building the global *external* to the company through the FCC, WARC, the US State Department, and the WTO.

Such tension soon was thrown into higher relief. Though acquiring $1.6 billion in equity investment marked a critical milestone in the venture, Iridium

would need upwards of $4 to $5 billion more to reach commercial readiness in 1998.[73] These monies were to cover the full cost of the manufacturing and operations contracts as well as day-to-day business operations as the enterprise ramped up and added staff, going from tens of employees to hundreds. The bulk of this support was to come from the world of commercial financing through a variety of instruments: a bond offering, an IPO stock offering, and a bank facility (a line of credit)—in that order.[74] For a large venture this progression from equity as an initial step to subsequent financing was typical. The key thing for the investors, especially those other than Motorola, was to have a clear narrative of the trajectory of how money would be raised—to assure equity investors that their funds actually and effectively could leverage the business to fulfill its objectives. As Leo Mondale characterized it, "there had to be a story of how the first dollar would be raised and how the last dollar would be raised."[75]

This was not merely about the sequence itself, but about how the different financial sources viewed the credibility of the venture; the step of raising equity in sufficient quantity provided the foundation for acquiring financing through bonds (and on to the next step). The critical planning in the company was to know in advance how much equity, measured against the business plan, provided a forceful argument to the bond community for arranging a bond issue. Given the venture's multiple uncertainties, such an exercise, too, was to prepare the original investors for the possibility of asking for additional commitments of equity. To do such planning Iridium and Motorola, from the effort's earliest days, arranged for Goldman Sachs to serve as financial advisor. Its analysis provided the basis for the amount of equity Motorola and Iridium sought from 1992 to 1994. This judgment came to a head in 1995 as Iridium pursued bond financing, in which company executives organized a "road show" for various financiers, an effort that aimed to convince them to facilitate a bond offering.[76] To the surprise of Motorola and Iridium, this appeal failed. The critique they received was that, not withstanding Motorola's backing for the venture or Goldman Sachs's analysis, the equity raised was insufficient to balance the multiple risks of a project that planned to build and operate a global infrastructure. Another infusion of equity needed to be raised to gain bond market support.

At this point in the venture not a single satellite had been built or a gateway emplaced, nor had the mechanism for key business functions such as billing and settlement of call charges been developed. Though substantial work had been done, especially on the engineering side, Iridium still remained largely a paper exercise, defined by its business plan and intangible assets such as spectrum

allocation from the ITU and the FCC. Iridium's leadership—Bob Kinzie, Jerry Adams, and Leo Mondale—viewed the "road show" defeat as a critical moment of reassessment and reorientation that intensified the fissures of the project. As the original investors reached deeper into their pockets—for another $300 million in funds—their self-conception of their position became clearer. Rather than serve as relatively passive participants whose managerial role was titular, they would have to be more active.

As with the original rounds of investment, these extra monies largely supported the costs of the manufacturing and operations contracts and thus, as before, passed through to Motorola—an add-on, at the same moment, to the costs of the TNDC, which the investors also incurred. The negative message from the bond community and the fallibility of Goldman Sachs in predicting that outcome made clear the investors had, at least in minimal fashion, to push for a greater managerial role in the venture. This was balanced against the structure of Iridium, designed to have a strong, central US-based corporation supplemented by a dozen franchises that worked with Iridium on an episodic basis through board meetings and the like. This structure of center and periphery, with its echo of older colonial models, disadvantaged in other subtler ways the ability of the far-flung gateways to participate in management—through the use of US forms of corporate governance, US contract law, and English as the dominant language of communication. Not least, it was balanced, too, as already noted, by investors' lack of business skills appropriate to Iridium's specific challenges as a globally defined telecommunications company. These events made the tensions in the enterprise visible and amplified their importance, but the Iridium structure did not facilitate their ready resolution.[77]

After the investors raised the additional capital, Iridium did succeed in arranging a successful bond issue. But as with the investors, the "road show" episode also changed the perceptions of Iridium leadership. To that point, external actors largely saw the company as an adjunct of Motorola, indicative of the origins of the project and its early development. In presenting the project to the scrutiny of the financial community, though, that changed. These external actors viewed the company on independent terms—as a separate company, defined by a specific profile of risk and reward. This changed perception shifted Iridium's view both of the role of Motorola in the venture and of the investors. In pursuit of a business and conceptual notion of the global, Iridium had become factionalized.

In this process, the special role of the finance community was crucial. Prior to the mid-1990s, assessments of the project rested primarily on trust. At the FCC, at

WARC, and with the original investors, the deciding factor in providing approval or funds was belief in Motorola's reputation. In each of these venues, of course, Motorola provided substantiating details—but those supporting details came primarily from Motorola itself. As the venture had to explain itself to the financial community, the company's structure, business plan, and claims of capability were, for the first time, subject to substantive, external scrutiny. From 1995 on, this scrutiny became a nearly daily fact of life for Iridium as the company raised additional capital from bonds, the stock market, and bank facilities. As it did, the financial community became part of the process of composing Iridium's global, but in a way that had an ambiguous effect. It provided the critical resource of the venture—money—but at the same time the near constant pushing to have risks fully articulated and made visible intensified the pressures and differing interests among Motorola, Iridium, and investors (especially those outside the United States). Though financial documents identified numerous risks, highly relevant were those derived from the center-periphery model and the associated political and operational challenges posed by the periphery—those gateways outside the United States and Europe. But these internal tensions, visible and problematic, were heightened by one firm condition imposed by the financial community. In 1997 and 1998, as Iridium arranged a series of lines of credit through Chase Manhattan and Barclays de Zoete Wedd, or BZW (the international investment arm of Barclays Bank), they set a decidedly less ambiguous requirement on Iridium: a mere several months' schedule to meet specific subscriber and revenue targets once the business became operational in the fall of 1998.

Time always had been a critical driver of the project—as an abstraction of the market and its rigors, as an engineering and manufacturing ideal, as a benefit of the completed system in making the global an item of consumer control. Time, in the context of financing, though, became a kind of wall. If Iridium proved skillful enough it would circumvent this obstacle, or, if not, the venture would crash into an immoveable object. As Iridium moved to commercial operation, this unwieldy apparatus, designed to create a global service, through multiple moving parts, distinct in their post–Cold War configuration, distinct in their fragility, hoped to avoid that epic crash.

Chapter Four

"Freedom to Communicate"

Ideology and Culture in the Global

> *Freedom to communicate, anytime, anywhere*
> For the first time, Iridium shrinks the size of instant, reliable, truly worldwide communication to fit comfortably in the palm of your hand. And with a single telephone number, it follows you from isolated regions to international capitals, across borders, oceans, time zones . . . simply stated, there is nothing like Iridium. And for someone like you—who sees the world as one—there will be nothing in your way.
>
> IRIDIUM ADVERTISING BROCHURE, 1998

> The half century since the end of World War II has been a period of unprecedented American hegemony over the rest of the planet. The confident mobility and the implicit threat that go with an aerial perspective have helped give a face to that hegemony. . . . The United States has demanded, as a sort of natural right, that its citizens and media be able to pass unhindered across the borders of nations and continents. For fifty years, the assumed mobility of the view from above has been a virtually unavoidable component in a sort of unconscious popular cosmopolitanism, a set of expectations about the openness and submissiveness of the world that are shared widely even among Americans who never leave their country.
>
> BRUCE ROBBINS, *GLOBAL FEELING*, 1999

To wander onto the terrain of the 1990s global is to invite disorientation. Its media expressions and literature seem a jumble of outlooks—of promotion and critique, of declamations of control and unruly realities, and of totalizing visions and their limitations in an ever locally grounded world. These introductory quotes, nearly contemporaneous, offer a taste of these jostling perspectives. One highlights the confident entitlement of business-class travelers living in a capitalist world tailored to their needs. Techno-enthusiasm and a "master of the universe" vibe seem to promise smooth transit across the global stage. Yet hints of disorder come through in the acknowledgment of "isolated regions." Unpredict-

ability and risk seem to shadow the exhilaration of global motion "for those with nothing in their way." In "seeing the world as one," the text implies an alternate world that is not-one, of stratification between haves and have-nots, of a reality of locally grounded differences and opposition.

The other quote lays out a classic and germane critique, suggesting the post–World War II lines of power that have helped make that business-class vision seem natural. The handy organizing lens of hegemony, or empire resolves the churning of the global into neat familiar patterns of dominance and accommodation, of center and periphery. The Iridium story certainly offers good empirical meat for this assessment. But here, too, the analysis seems tidy, leaving aside the actual functioning of hegemony and of US-style "unconscious popular cosmopolitanism." The question remains: how might a ground-level view of the 1980s and 1990s complicate this analytic and our understanding of the coursing flows of capital, commodities, signs, peoples, cultures, and the planet-embracing technologies of satellites and fiber-optic cables?

The disorientation of the global, its slippery resistance to simple explanation, rests in its hybridity, of pushing Western constructs and actions into tension and confrontation with non-Western practices and ways of doing. In the post–Cold War period, this engagement takes place in a specific frame of ideology and practice, neoliberalism: a belief in markets as the preeminent mechanism for stimulating economic creativity, for promoting individual freedom and self-determination, and for achieving progressive social transformation. The market, rather than the state, exemplifies the quest for realizing Enlightenment universals and serves as the ideal for the regulation of the social sphere (as an inseparable adjunct of the economic sphere). Neoliberalism secures the standing of capitalism, but with a twist. It legitimated classic modes of dominance *and* the claim of their possible reconstitution into structures that enhanced the capacity of individual and community self-determination.[1] Iridium's moment in the 1990s thus was not that of imperialist enterprises in late nineteenth century or the 1920s. Different value structures were in play, ones that at least gave a rhetorical nod to postcolonial independence movements and the agency of non-Western actors. Institutions such as the United Nations gave substance (if only partial) to the transformation of pre–World War II patterns of imperialism. These political and institutional shifts, in turn, shaped and helped legitimate the rise of neoliberalism in the post-1970s period; both outlooks drew on, in somewhat different ways, the transnational cultural power of universalism. The deeper question that has preoccupied postcolonial and globalization studies is whether Western leverage (primarily) oper-

ated with hegemonic gusto (the first half of the neoliberal equation), or whether countervailing interests forced some kind of co-construction, of mutual agency, in which individual and communities shaped the global (the assertion of progressive benefits in the second half).[2]

In broad, simple strokes one must draw into the frame a range of hybrid encounters. Developed countries conjugated in new ways with the less developed, some of which became robust members of a market-centered international order. Western, especially US, commodities and media products, with seeming relentlessness, penetrated nearly every national and cultural context. Diasporas of peoples from nearly every less-developed region entrenched in the developed world. As capital, people, and images circulated and new zones of contact formed, the meaning of "nation" and "individual" were recast. In this recasting, as an important subplot, the military and the market accommodated and reinforced one another.

Enlightenment tropes circulated as universal standards of what it meant to be human and a citizen in the late twentieth century. In the 1980s and 1990s market era, corporations, those most interest-driven of creatures, came to stand for those ideals and to serve as emblems of progressive social transformation. Peoples still defined in some measure by the nineteenth- and twentieth-century legacies of European and US imperialism deployed those tropes differently and in tandem with this ethos—to resist and reframe their experience with the market and reconfigure their own identities and aspirations. As the West's markets and corporations flexed in new ways, the idea of Europe and the West became de-centered—the problem of the "local" stimulated a realization that Enlightenment ideals were not "above history" but an accompaniment to the particularities of pre–World War II European expansionism. History itself as an intellectual construct became confounded (do the concepts and methods we have used to organize the past speak to a global period?).[3] And, as indicated by the two introductory quotes, the global and its critique unfolded in unison. Everything seemed in flux.

But in what ways? In reflecting on Iridium's ideology and image, one might echo the analysis of Bruce Robbins above, or like the French theorist Pierre Bourdieu argue that the posture of the 1990s global is captured in a simple equation: "Cultural imperialism rests on the power to universalize particularisms linked to a singular historical tradition by causing them to be misrecognized as such."[4] But does this view, with its proper emphasis on power as a critical lens through which to assess the period, address the central historical questions? How does power

operate? Who wields it and to what effect? Is it descriptively complete to suggest that power primarily manifests as an instrument of those classic actors, the state and the corporation, or, contrary-wise, as forms of resistance to those actors? To argue that ideals described as transcendent serve as a cover for baser designs?

Bourdieu's larger body of work, though, raises an additional analytic problem in thinking about power and agency in the global. To draw on his and the literature of other critical theorists' work on post–World War II capitalism, one might see the shifting, increasing flow of commodities and media signs as a prominent form of *diffuse* power, a field of daily experience sometimes aligned with but often distinct from the purposive interests of *all* political actors. Seen in this context, those transcendent ideals perhaps operate in a more complicated fashion, not merely as ideology flowing along the force lines of the imperial, but as beliefs adopted in many communities and used as intellectual and political resources for a variety of locally defined ends. Or, said slightly differently, and adapting Daniel Bell's argument in *The Cultural Contradictions of Capitalism*, culture (as a system of values, practices, and signs) might both serve and muddle the capitalist enterprise.[5] Agency and explanation in the global is not just a problem of applying a hegemonic analytic or of uncovering mutual agency and co-production, but also of this amplified condition of semiotic experience—what Fredric Jameson has called a "second nature."[6]

From its inception, Iridium confronted as a foundational problem such intersecting meanings of the global—and the fact that as a nexus for corporate, state, and media actions the venture was itself part of the very process of creating those meanings. This circumstance permeated the enterprise: in the design of its communications system, work practices on the manufacturing floor, corporate efforts to bring into the frame of planning the identities of Motorola and Iridium employees, the financial and political organization of the project (especially in its involvement of many non-European and North American investors), corporate lobbying to create favorable national and international trade and regulatory regimes, relations with the US military, and as ideology and image. And when, on occasion, Motorola and Iridium had to define their view of the world explicitly they confronted an undeniable reality: that through this venture a major US corporation was looking to extend its already multinational business interests into new realms—but in a landscape that both facilitated prior methods of power and reshaped them. The fluid nature of the 1980s and 1990s market-global allowed this reality to be framed in different ways, with different emphases. Image, ideology, and business goals could be configured to make near-polar opposite messages

possible and plausible; sincere identifications with Enlightenment-oriented values *and* pointed ideological communications, reminiscent of earlier imperialist outlooks, both came out of the project.

This chapter explores these expressions of ideology, images, and culture and their connections to the global. The goal is not to provide a clear resolution to the disorientation sketched above, but to follow Iridium, to see these tensions in play. What follows is selective. Most of the historical evidence is US-centric, deriving from the actors at the center of this story. The views and actions of non-US participants in Iridium have been harder to come by. It thus privileges the center over the periphery. Still even this truncated account can add something: those Western actors—corporations and their nation-state partners— so central to our understanding of the 1990s global have not yet been examined in detail. The chapter offers three takes on ideology and culture in Iridium. The first considers Iridium's treatment in the media, primarily in the press and the then emergent domain of the Web. A second looks at a Motorola-generated manuscript, co-authored by Robert Textor, an academic anthropologist, and R. S. Moorthy, the director of Motorola University's Center for Culture and Technology, and developed in a succession of drafts over the 1990s, entitled "'What Hath God Wrought?': Anticipating the Human Impacts and Sociocultural Implications of the Iridium Revolution" (later retitled "The Iridium Revolution"). The third is the development and rollout of Iridium's branding and advertising campaign in 1997–1998.

Iridium, the Media, and the Neoliberal Global

The history of the intellectual crosscurrents of the last decades of the twentieth century only recently has begun to be mapped out, including understanding how neoliberalism rose as an ideology and achieved a prominent position in Western culture, to detail those communities of discussion, institutions, individuals, and media patterns that gave it life.[7] One aspect of the ideological turn to markets has been sketched by Daniel Yergin and Joseph Stanislaw in *The Commanding Heights*.[8] They offer an account of how market ideology gained traction in the politics of the United States and Europe through a network of academic advocates (particularly through the University of Chicago), conservative think-tanks, and longstanding pro-business publications such as *Fortune* and *The Wall Street Journal*. International connections also were essential to this movement, as US-based academics assisted international organizations and advised on how to invigorate the economies of developing countries. Chile, prominently, became an example of the virtues of market ideology and practices as that country trans-

lated its economy from a socialist to a capitalist model. The turn to the market thus was not just about how to organize the US economy, but an argument for reconfiguring the global landscape.

But market talk—despite its increased prominence in US electoral politics over the 1970s and 1980s—was largely a conversation and an ideological contest among elites, impassioned but largely abstract. Frederick Turner's *From Counterculture to Cyberculture* suggests how 1960s counterculture thought, which placed a high value on romantic individualism and small-scale communitarianism, converged with elite market talk to enrich neoliberalism's intellectual ambit and social resonance.[9] The vehicle for this convergence was personal computing—or, more specifically, the genealogy of this development, its strong sociological connection to countercultural figures, such as Stewart Brand, and to countercultural networks and enclaves, such as the Well, the *Whole Earth Catalog*, and liberal-oriented universities.

As an emblem, personal computing performed double duty. It stood as an icon of the market, of individual and small group creators and entrepreneurs, of capitalism's ability to generate the new, to transform and expand the range and quality of services and goods, to highlight technological innovation as a beneficent engine for making an ever-better future. It thus aligned with the main tenets of the American business ethos. As the complex of personal computing activities moved from universities and home workshops to firms employing hundreds or thousands, it became part of the landscape of big business.[10]

But personal computing, trailing its countercultural roots, also connoted the *non*-market—of individuals and groups pursuing interests that transcended the grind of capitalism. This view seemed legitimated in that this culture embraced concurrently profit-driven action and communitarian ventures. In this symbolic frame, the market thus was merely a handy vehicle for promoting widened opportunities for collaboration and for individuals to shape their identity and place in the social order. Profit-making might be an end but also prominently a means. This strain of market ideology added a crucial element to neoliberalism, linking the market with notions of progressive social and political transformation. Enlightenment universalisms seemed not just abstractions but realizable through the specific resources and practices enabled by personal computing. With its emphasis on the amplified potentiality of individuals to shape their own worlds, personal computing culture, too, gave a whole new edginess to market life. Participation in the market potentially was not just about a regular paycheck or being a passive consumer; rather, it held the promise of experimentation and explora-

tion. It was vital and cool, an opening to new worlds. It was about being in the vanguard of social change, of being a new kind of citizen, of creating the future, not just on a national but on a grand international scale.[11] Tinged with utopianism, it took the totality of humanity as its possible field of action. This powerful sense of transformation, this seeming unsettling of established patterns of economic and social power, elevated in importance a formerly little celebrated social group—the nerds. The nerds became the new every guy and gal, smarter perhaps, but driven by a humble small "l" liberal political ethic. Their emergence as social icon seemed to invite everyone (potentially) to the transformation party.[12]

The foregoing is not to say that elite and countercultural takes combined into a coherent ideology—the neoliberal was rather a constellation of positions, some quite contrary in their implications, but all of which took the market as a fundamental point of reference. Indicative of this was the generally positive cultural valuation of "high-tech," particularly as the Cold War waned. This valuation derived, in large part, from a longstanding fascination with the Cold War emphasis on innovation (even when tinged with fear or outright opposition); from innovation's traditional perceived role in economic advancement; and, in the 1970s and 1980s, from high-tech's role as a defining element in US standing in the international economic order. The origins and development of the Internet, from a national security tool to a signature symbol of the fusion of counterculture and the market, was an exemplar of this herding together of not fully compatible value systems. The special emblematic status of the Internet and personal computing—the cynosure of high-tech—and their association with an ethos of progressive social possibilities muted the different genealogies and different purposes of other areas of high-tech. All high-tech—as covered by traditional media—seemed to benefit from a default view that it contributed to the social good, at least at first blush. Military-generated technologies, big business developments, and Silicon Valley start-ups all seemed variations on a fuzzy, neoliberal progressive theme.[13]

These positive attitudes toward business and high-tech, entwined and reinforcing, helped strengthen a long-appealing narrative in American life: of the business leader as a hero and as a beneficent shaper of the social order. By extension, the corporation in the neoliberal context possessed the same attributes. This cultural stance (while not without criticism or opposition) held extraordinary sway through the exertions of a wide range of promoters—from business leaders themselves (including those in the information sector), to major news organs, to think-tanks, and to a vastly expanded business press. The latter tapped

into the rising tide of the neoliberal, creating and feeding an appetite for a literary genre featuring the exploits of CEOs, corporations, iconoclast innovators and marketeers, wealth-making, the *next great thing*, and the future as an unfolding terrain awaiting its techno-political possibilities. Such cultural leanings helped neoliberal luminaries such as Peter Drucker and George Gilder stand atop best-seller lists and make business news a cable television growth industry. All this enchantment with business and business leaders during the 1980s and 1990s gained immediacy through a "by the people, for the people" practical development—the shift from defined-benefit to employee-contribution, stock-based pension plans—making the market and market ideology an everyday, sitting-around-the-kitchen-table preoccupation for many in the middle class.

From its inception in the early 1970s through its network of individual and institutional promoters, neoliberalism aspired to international legitimacy. The fall of the Berlin Wall in November 1989 raised the ideology to a new level of prominence, clearing the Soviet Union and its state-centered economic practices from the field of international competition. The moment was not lost on neoliberal exponents, one of the foremost of whom was Francis Fukuyama. His late 1989 essay "The End of History?" gained near-instantaneous recognition as *the* signature statement of the triumphant standing of market-centered ideology.[14] If taken at a news-bite glance, the essay's argument could easily be misinterpreted. The "end of history" was not a seemingly weird philosophic statement claiming that human affairs, in their meaning or motion, had stalled or arrived in some static neverland. It was a historical claim that the more than century-long contest between capitalism and its principal ideological antagonists, communism and socialism, had largely evaporated. "History" now would be shaped by the unfolding of one dominant ideology, rather than through a dynamic of conflict. In his somewhat stilted prose, Fukuyama offered that "the growth of liberalism seems to stabilize in the way one would expect at the end of history if it is underwritten with the abundance of a modern free market economy. We might summarise the content of the universal homogenous state as liberal democracy in the political sphere combined with easy access to VCRs and stereos in the economic."[15]

Motorola unveiled Iridium in June 1990, seven months after the richly symbolic Berlin event had cascaded through the transnational mediasphere. From its public debut, Iridium's meaning was shaped by the cultural, ideological, and historical shifts and events of the 1970s and 1980s, accelerated by the disintegration of the Soviet Empire. The tangle of neoliberal positions all found a toehold in Iridium, making the project a handy symbol of the post–Cold War moment. Its

enamoring qualities abounded, with forward-leaning attitude as important as its practical goals and possibilities:

- big technology (what's bigger than the entire planet?)
- market actors supplanting the state in a signature area of national technology—spaceflight
- an established Fortune 500 company that rolls the dice on a super-ambitious idea
- the "aha" inspiration for the project coming from three unknown engineers working in the Arizona desert
- the project's layers of daunting challenges, ranging over the technological, bureaucratic, and political
- internationalism on steroids, even drawing former Cold War adversaries into the embrace of a US capitalist enterprise
- putting an exclamation point on the booming, utopian obsession with communications by offering a fully global network for individual users on the move

Knowingly and unknowingly Iridium's leadership tapped into the prevailing cultural currents—as did those who reported on it through the 1990s. Motorola's public rollout of the venture in June 1990, covered in chapter 1, captured this mix of connections to period fascinations and set the tone, supportive and critical, of media coverage in ensuing years. The four press events held simultaneously in London, Melbourne, Beijing, and New York City composed a tableau of the moment, entwining the post–Cold War stance on markets, geopolitics, and the transformative possibilities of communications.

Adding to the "what to make of it" factor was Motorola's political and public standing in 1990. It had emerged from the 1980s as a poster child for how American firms might reinvent themselves in the face of intense global competition, particularly from Japan. In 1988, the company received the first Malcolm Baldridge National Quality Award, established in 1987 by Congress and each year presented by the sitting president to encourage extraordinary accomplishment in improving manufacturing techniques and quality control. Linked to this achievement was the company's striking success in building and benefiting from the fledgling cellular telephone market—its "bat-wing" logo cell phones had become an early icon of the consumer adoption of the technology. When President George H. W. Bush campaigned for reelection in 1992, he made a point of visiting a Motorola plant in Schaumberg, Illinois, home of the company, to make a pitch

for his Agenda for American Renewal, a response to a then weak economy. In a speech at the plant, referring to the award and the company's national and international business triumphs, Bush offered:

> if [we] use this as a microcosm of our country, they're [Motorola workers] writing the future for our whole country, the future for the United States of America. What you are doing is the perfect putdown for the professional pessimists, the doomsayers, some of whom say we cannot compete in a changing world. And you've taken the challenges of this new world, and you have done what America has always done—reinvented them as opportunities for yourselves, for your families, and for every single American.[16]

Although expressed in 1992, this sentiment (with allowances for inflated presidential campaign rhetoric) reflected Motorola's high standing in elite political circles and with many consumers.[17] These perceptions of Motorola only added to the stakes and geopolitical issues that circled around Iridium's public unveiling with splashy media events in signature global cities.

As outlined in chapter 1, the geospatially distributed four-events-at-once display garnered an enthusiastic media response—even if accounts did not quite know how to focus their narratives and settle on defining metaphors. In linking science-fiction visions (with a dash of techno-religion) to Iridium, *The New York Times* came closest to capturing the range of meanings embedded in the project, tying together themes of the global, relentless innovation, and the centrality of markets and corporate-driven leadership:

> The small and portable telephone that can be used anywhere on earth has been a staple of science fiction and a Holy Grail of telephone engineers for several decades. Today Motorola Inc. will become the first company in the world to announce plans to build and operate such a phone system . . . a 25-ounce handset that would fit in an overcoat pocket and could allow the user to make and receive calls from the North Pole to Antarctica. . . . Motorola is the nation's third largest electronics company . . . and is known for its technological wizardry in developing mobile communications products.[18]

Motorola itself sought to sustain this type of narrative. Soon after the public rollout it embarked on an advertising campaign featuring satellite graphics and made an explicit connection between the company's international reputation in communications and the new venture: "Our experience in committing to new ideas gives us the conviction to act, filling the needs of a fast-moving world. . . . Our

satellite-based Iridium system is intended to bring personal communications to every square inch of the earth. Today's surprises are tomorrow's businesses. For us, and for our customers."[19] In early 1992, the *Times* returned to Iridium, noting that the project "continues to engender both awe and skepticism. . . . Awe, because only a company of Motorola's standing . . . would hazard so vast a project, a constellation of 77 satellites arranged in Copernican complexity. Skepticism, because even Motorola might not solve the daunting financial and technical problems of building an airborne A.T.& T. and then finding customers for it."[20] To emphasize the venture's forward-looking-ness, the author quoted Iridium Chairman Robert Kinzie: "This is not just a phone; it is a vision."[21]

But most early media accounts, including that of neoliberalism booster *The Wall Street Journal* (which carried the Motorola ad), focused tightly on typical business factors: the risks, the technical complexity, the cost, and the bureaucratic and political hurdles. Such accounts acknowledged that the undertaking was novel and big, yet wondered how the venture might fare in the real world, as it had to grind from concept to operational fullness. Such renderings were less about skepticism derived from careful analysis than an indicator of how global market talk had become natural. Even new, dramatic initiatives such as Iridium were assessed against this cultural backdrop. Too, such reporting reflected a muted corporation-as-hero narrative—to reach a goal the protagonist must first pass through travails, surmounting and succeeding or faltering and failing. This journalistic mode was commonplace during the 1990s, but shifted over time. As Iridium unfolded and began to make progress in addressing its multiple challenges, neoliberal enthusiasms began to cohere into a more dramatic and energetic narrative.

In part, this was due to other corporate competitors entering the satellite telephone fray, intensifying and making more real those neoliberal themes linking the global, markets, and individual empowerment. Another was the emergence of even more grandiose space-based proposals to provide high-speed data (not merely voice) services to users around the world. The foremost of these was Teledesic, announced in 1994 and backed by outsized business-cum-mass culture personalities Bill Gates and Craig McCaw. Their project, in particular, signaled the rapid ascendance of the World Wide Web, the friendlier, more engaging, adaptation of the Internet. As Iridium did for cellular telephony, Teledesic, with its promise of planetary coverage, heralded the possibility of bringing the benefits of networked personal computing to users everywhere, adding symbolic heft to the Web's potentiality for social transformation. The rise of the Web fostered

new genres of information-sharing and discussion—bulletin boards, chat rooms, and specialized, dedicated websites such as Slashdot.com and Motley Fool—that energized connections among computer-based communities, nerd passions, technology, and markets.[22] Iridium was part of an evolving story. Despite its obvious genealogy in big business and Cold War technical capabilities, the project's symbolic resonances—within Motorola and Iridium and the popular media—found stronger harmony with those counterculture values that inhered in the Web world.

No publication captured and gave expression—as boldly and broadly—to this assemblage of commitments, values, and excitements better than *WIRED* magazine. Founded in 1993, the publication was the creation of old counterculture hands, including Louis Rosseto, who claimed that the 1960s icon *Rolling Stone* magazine served as a template.[23] *WIRED* made explicit neoliberalism's fundamental appeal: that the cocktail of markets, technology, and individualism fed on deep, compelling emotions—of individual and group identity–making and of a sense that those in the know (*WIRED* readers and their social kin) were fashioning a new historical era. They were pioneers, tilling a new land with new tools, making a new culture.

In its first year the magazine turned its attention to Iridium, publishing a feature article by Joe Flowers, entitled simply "Iridium." But the first paragraph showed the *WIRED* narrative style, a hip fusion of technical and business doings with questions of their meaning for the social and personal:

> As big business goes, it doesn't get any bigger. Imagine a 66-satellite system of such stupendous ambition that you can phone anyone, anywhere on the planet, even if that person is standing in the middle of the Sahara, or Antarctica. Cost: $3.4 billion. Players: Motorola, the big Japanese electronic companies, dozens of local PTTs [Postal, Telegraph, and Telephones], an alphabet soup of national and international regulatory bodies. Here's the story of a dance that tells us a lot about who we are, what we expect, and how we deal with change at the end of the millennium.[24]

Then with a passing pop culture reference to Dick Tracy's wrist phone, the author, in a careful blend of tongue-in-cheek-ness and acceptance of the cultural assumptions of his *WIRED* audience, laid out a view of life in the global:

> But worse than that, a cellular phone can't easily leave town. Mine won't work at all in that big nothing on the drive to Las Vegas. I could be out of touch for

> hours. If I take the phone to another city, I have to set my phone to "roam" and pay extra. If I go to Europe, the phone won't work at all. . . . And even worse, someone who wants to call me has to know what part of the world I'm in. This can be a real problem. No, I'm with Tracy—I want a real phone, something I can toss in the pocket of my genuine Banana Republic photojournalist's vest and take anywhere. I want my agent to dial my number and get me, whether I'm chatting with roustabouts in the oil fields of Kazakhstan or sipping kava in the Friendly Islands.

But such a narrative, of course, was not about the expectations of the author, but of his like-minded readers:

> I know this problem worries you, too. I can feel your frustration, as you wander the tombs of Monte Alban without any idea what the Nikkei's doing, or sit in traffic between Heathrow and Soho with no way of dialing up Lagos.
>
> Have faith. You have not been forgotten. The big boys are working on it. Give them another five years, and your troubles will be over. You'll be connected, always and everywhere, clear channel, error-corrected, voice- and data-capable, page-able, locate-able, and encrypted—all with one phone number, no matter where you are. Ask and ye shall receive.[25]

This telling captured one thread of countercultural neoliberalism—a certain self-indulgence and a tendency to see issues of political economy as a distant sporting contest. The *WIRED* style gave great weight to revealing the structural and power dynamics of the global but deferred any judgment or critique. The author neatly synopsized Iridium's transnational political maneuverings:

> What's really going on is something between a minuet and a World Wrestling Federation Monster Mash. . . . The dancers include all of the companies involved [Motorola and the other companies proposing satellite telephony systems], plus the departments of state and commerce, the FCC [Federal Communications Commission], various world bodies, a hundred or so national phone companies around the globe, commercial airlines, technology giants in Europe and Japan, rocket makers in Russia, and even radio astronomers. . . . The dance is political and corporate, but its realities can only be descried deep in the differing technical choices made by Motorola and its competitors. Each technical choice affects the business end; the business decisions push the politics; the politics mold the technology, around and around it goes.[26]

What made a story like Iridium's interesting was that all this churning involving the "big boys," in effect, coincided, at least superficially, with countercultural support for techno-political transformations that seemed to facilitate individual empowerment. Missing were those 1960s countercultural questions that asked about modes of production and how the networks of power that enabled them shaped the political field. That type of critique would erupt, from other quarters, as global trade regimes such as the World Trade Organization (WTO) drew deeper scrutiny and organized political protest.[27]

Media coverage (primarily newspapers and magazines) in the several years after this *WIRED* piece predominantly focused on discrete developments in Iridium—investments, regulatory hurdles cleared, top management changes, launch agreements with China and Russia, progress in satellite manufacture, and comparative takes on the project in relation to its primary competitor, Globalstar. In covering these developments, accounts often raised the question of whether the rapid deployment of ground-based cellular networks was undermining the business rationale for Iridium. This skepticism, again, reflected a "can the hero overcome travails to fulfill the quest and reach the goal?" But this plucking at the hero's cape became muted as Iridium began a historic and impressive run of rocket launches beginning in May 1997 and continuing into 1998, creating in less than a year the biggest, most complex satellite constellation ever put into space. *The New York Times* 1990 headline "Science Fiction Nears Reality" received its bookend complement in the spring of 1998 in an article entitled "Iridium Satellites Close to Girdling the Globe."[28] The market had achieved a communications feat that exceeded anything attempted in the decades-long history of state-sponsored space activity.

Alongside this more traditional reporting on Iridium, the venture also integrated itself into the unfolding developments of neoliberal politics and culture. Responding to the dramatic spread of the Web and its burgeoning spectrum of international users, the company created a corporate website. This was a static, description-tilted presentation, but made especially concrete the striking array of international corporate and state investors in the project. More in active conversation with the cultural moment was an in-house corporate magazine, also established in 1996, first called *Iridium Today*, then renamed *Roam* in early 1998. In the business-enthusiastic 1990s, the corporate magazine was an expanding genre. And for good reason: it filled a hybrid space in which a corporation could attempt to appeal directly to potential customers, well-heeled travelers, and the media. In one literary stroke, it reached out to shape its base of consumers and to

introduce perceptions and symbols that might gain circulation in the wider flows of the media. *WIRED* magazine took note of this phenomenon and dubbed those corporate technology publications "gadget gazettes." It described *Roam* as a cross between "*Conde Nast Traveler* and *Forbes*."[29]

Love of the gadget as gadget was part of the magazine's slant, especially in its first years. But as the name change to *Roam* suggests, it also attended to readers' desires to link a "thing" to a complex of lifestyle interests and preferences. This was part of an attitude toward consumption that the *Harvard Business Review* dubbed the "experience economy"—consumers increasingly tended to see purchases as opportunities to create a narrative about their own lives.[30] As *WIRED* insightfully noted, for Iridium this taste for techno-fetishism combined with a salient fact:

> In fact, if anything, *Roam* tries to generate demand where supply is as yet unrealized. It is a gadget gazette that is, so far, mostly a tease. . . . Not that one should underestimate foreplay as a primary component in commercial transactions. . . . If anything, the "experience economy" . . . is becoming more a part of our lives every day. The success of gadget gazettes is that they do what objects cannot: They put the product into a context, an environment that shows the product being used.[31]

Iridium played to this in a number of ways, including emphasizing the theme of wanderers-and-seekers who traversed the international landscape in search of meaning and experiences—achieved through intimate connection with choices in consumption. In this vein, the company sponsored the Iridium Adventure Series, which included the Eco-Challenge in Morocco, the World Championship Nippon Cup, and the Dakar Rally, tapping into the global-leaning consciousness of environmentalists and extreme sports enthusiasts.[32] It also served as one of the sponsors for the Iditarod dog race. To appeal to another social niche the firm convinced Neiman Marcus to carry the phone in its prestigious Christmas catalog, known as *The Book*. A Neiman Marcus spokesperson explained that the "offering is consistent with our desire to be associated with only the top products, services, and companies. Our customers are among the busiest most well-traveled in the world. They need to be in touch, no matter where they are or what they are doing."[33]

As the last word in the phrase "experience economy" highlighted, narrative-centered consumption also was a statement about political economy. The Iridium magazine followed this thread, covering the middle registers of globalization that

did not typically surface in the major media. One type of social site instrumental in connecting the developed world and the developing world over issues of regulation and investment was the international trade show. Not atypical of the phenomenon and its value to Iridium was how this event was summarized in the magazine:

> Film has Cannes, fashion has Paris, and telecommunications, of course, has Geneva. . . . Telecom 95 confirmed that the telecommunications industry is booming indeed. Nearly 200,000 people, including some 400 government ministers, 2,143 journalists, and thousands of others, descended on Geneva for the 10-day event. Nearly 800 exhibits from 46 countries were featured. The large ones cost millions and featured lavish displays, including laser shows, glass elevators, and waterfalls. For the uninitiated, it was difficult to see beyond the dazzle. One industry veteran was overheard debating the merits of underwriting construction of a hospital instead of pouring funds into an exhibit booth that would be ogled and then dismantled eight days later.[34]

Without any sense of dissonance, the review continued: "Telecom 95 was distinguished by its international themes, including an opening ceremony speech delivered by South African President Nelson Mandela. His speech was an eloquent plea for including the developing world in the global information infrastructure."[35]

During the mid-1990s, Iridium Chairman Robert Kinzie traveled to and spoke at dozens of these conclaves in every region of the world. For example, in September 1997 he presented at the World Economic Development Congress a message with the theme of "Developing Infrastructure in Asia." Iridium had launched the first satellites of its constellation, poised to fulfill its global communications goal. In his speech, Kinzie offered that "Iridium and the other LEO [low Earth orbit] systems will come to stand for a new pan-terrestrial force: the power born of the fusion of peerless space technology with advanced land-based networks . . . ushering in *the age of instant and unlimited information* [emphasis in original]." That Iridium had investors from China, Taiwan, Korea, Japan, Thailand, Indonesia, and India gave special meaning to this transformation, representing within Asia a "new culture of visionary development," a contrast with 1950s and 1960s modernization efforts. "Instead of depending on incomplete or overburdened terrestrial networks, Asians will be free to make calls and receive calls virtually anywhere, at any time," whether as part of business, family life, or leisure if "hiking through the Himalayas." The result would be that "with Iridium and the next

generation of wireless technologies, the whole world is First World," a seemingly at-last realization of decades of modernization efforts sponsored by the United States and Europe through the World Bank and the International Monetary Fund (IMF).[36]

These international extravaganzas revealed a deep tension in the day-to-day process of constructing the global. Corporate and consumerist excesses intermingled with nation-straddling issues of wealth disparity and political equity. Government and international regulatory officials mixed with CEOs and salespeople, developed and developing worlds convening under the same big top. In pointing to the contrast of the "ogled" exhibition booth and the need for hospitals, Iridium marked the fault line that it walked. It needed the on-the-ground good will and political support of those in the developing nations and sought to use its leverage in national and international forums to adapt local and global structures to its benefit. Such thinking led to Iridium's geographically diverse board membership. This balancing act was particularly noticeable in Iridium's several-year relationship with the United Nations's International Telecommunications Union (ITU). Their interaction began soon after the Iridium rollout announcement in 1990. The central issue was how a UN entity, which gave special weight to advancing the interests of developing countries, might adapt to the neoliberal agenda. By 1996, as Iridium's manufacturing and launch preparations were well along, that question had been answered completely. The ITU's positioning helped legitimate the neoliberal as the primary path to enhance economic well-being transnationally, including developing countries—a supposition evident in Kinzie's 1997 speech to the World Economic Development Congress. Iridium's "gadget gazette" was there to share this convergence of interests with its readers through an interview with Pekka Tarjanne, secretary general of the ITU:

> *Iridium Today*: What are your thoughts about the global information infrastructure?
>
> PT: My favorite quote on the global information infrastructure—or the global information society, as some people refer to it—is that it is not global unless it is really global. And if we look at the world today, there is a growing information infrastructure, which is becoming more and more important. It's the basic infrastructure of our information society. But it is not evenly distributed. We know that today, some two-thirds of mankind are outside of the telecommunications network. And so we are far from a global info infrastructure. But I think it is good to speak about globality,

> because that ensures that we look at the globe as our market . . . and I have said that on the global level, the ITU's role should be to make sure that there is global regulation whenever it is needed, but only when it is needed. Sort of a minimalistic principle.[37]

The secretary general, a representative of the non-market public interest on the international stage, invoked neoliberalism's most basic tenet—"that we look at the globe as our market"—a view perfectly in keeping with that of Iridium.

Major media outlets in the United States reported on Iridium in snapshots, with respect to both its activities and their meaning. Iridium's in-house publication captured a richer, if obviously slanted, view of the venture's alignment with globalization's main lines of power. Again, though, Iridium found its most adept scribe in *WIRED*—with its odd 1960s-cum-1990s counterculture interest in the big picture but muted concern for the real-world implications of the politics it so insightfully delineated. In October 1998, on the eve of the venture's launch of service, a much anticipated moment of vindication and triumph for Motorola and its start-up, *WIRED* returned to Iridium in a prominent feature story entitled the "The United Nations of Iridium."[38]

In the years since 1993, when the magazine first assessed the venture, the neoliberal outlook had gained credence, symbolized, for instance, in the establishment in 1996 of the WTO, in the enactment of the Telecommunications Act of 1996, and as exemplified by the seeming "march of progress" advance of communications technologies, particularly the exponential growth of the Web. In elite politics, Iridium had a ready connection with these developments. In 1996, echoing President's Bush's campaign stop at a Motorola plant, President Bill Clinton toured an Iridium manufacturing facility in New Hampshire, the event a microcosm of the interconnections among the global, technology, and politics. The complex of associations was more richly evident in the staging of Iridium's "cut the ribbon" inauguration of service in the fall of 1998, covered by *Roam*:

> *From the Rose Garden*: At midnight Greenwich Mean Time on Sunday, November 1, Iridium became the first provider of global mobile-telephone services. Helping us launch this new era of global communication was U.S. Vice President Al Gore, who placed the first official Iridium phone call on the preceding Friday afternoon. Standing in the White House Rose Garden, the Vice President used an Iridium phone to call Gilbert M. Grosvenor, chairman of the National Geographic Society and a great grandson of Alexander Graham Bell. To mark the occasion, the Vice President greeted Grosvenor with the historic

> words that Grosvenor's great-grandfather had spoken to Tom Watson, his assistant, when they completed the world's first telephone call in 1876: "Watson, come here, I want to see you."[39]

Gore's pop culture association with the Internet only added to the symbolism of the moment, in which the global present was linked to and then distinguished from the past.

WIRED's 1998 article began to connect all these dots of the global. The article began with—"it's a bird, it's a plane, it's the world's first pan-national corporation"—then gathered its analytic stride:

> The real importance of Iridium, however, transcends technology. Iridium is the world's first pan-national corporation, a global partnership created, from Day One, without control by any one country. It takes that emblem of 20th-century capitalism, the multinational company, and kicks it into the next millennium. When a Coca Cola, Siemens, or Ford expanded overseas, ultimate control remained—and profits were repatriated—at home. Iridium's core identity is defined by its transcendence of national borders, a structure that is particularly post–Cold War. It's a harbinger of what ever-less-restricted global free trade can bring about. If global privatization and the lowering of trade barriers continue, Iridium may well serve as a first model of the 21st-century corporation.[40]

Giuseppe Morganti, CEO of Iridium Italia (the business entity that ran the Iridium gateway to most of Europe), drew the contrast between an imperial past and the neoliberal present: "Multinationals are comparable to the idea of national colonialism, where cultures are places to be conquered. Iridium is something that starts as a global entity." The tail end of that analogy was left benignly unexamined: what kind of power structure was the pan-national global, and how might one characterize collaboration and absorption in distinction from colonial control?

On the surface, it looked different and had the edginess and energy of a new social experiment:

> Iridium's partners are assigned territories to manage on their own, forming separate companies. Fifteen of these operations, with names like Iridium Italia and Iridium China, have been started—each independent, each with its own CEO and governing board. Four times a year, 28 Iridium board members from 17 countries gather to coordinate overall business decisions. They meet around the world, shuttling among Moscow, London, Kyoto, Rio de Janeiro, and Rome,

> surrounded by an entourage of assistants and translators. Resembling a United Nations in miniature, board meetings are conducted with simultaneous translation in Russian, Japanese, Chinese, and English. The translators, ensuring that there are no misunderstandings, transmit the proceedings while they watch on TV monitors in an adjacent room.

This description of organization and process was largely correct, but did not get at whether all the partners were equal and, especially did not examine Motorola's special standing as the initiator, largest investor, and critical provider of the billions of dollars' worth of system hardware and software.

Despite a good feel for the global political economy, the author could not resist the neoliberal tendency toward the utopic; even the mundane mechanics of day-to-day bureaucracy seemed fraught with social transformation:

> [Arthur C.] Clarke's vision of global unification is already under way at Iridium's board meetings, where the economic interests of diverse investors are branching out beyond the consortium itself. It's an organic, bottom-up approach. With representatives from so many countries working closely together, Iridium is a matchmaker for introducing new pan-national businesses. Company board meetings coordinate global strategy; subcommittees do the grunt work—auditing the books, managing employee compensation, and fielding myriad financial questions.

Complementing all this collaborative activity at the top was the hands-across-the-oceans work of engineering and project management: "the [Motorola] production lines disgorged a finished bird [satellite] every four and half days, sealed it in a container, and placed it on the flatbed of an idling truck that drove it to California or Arizona, where a waiting Boeing 747 carried it to a launch pad in the mountains of Taiyuan, China, or on the steppes of Baikonur in Kazakhstan." Citing Clarke as a promoter of global comity, the author quietly introduced a key aspect of Iridium's global, utopian-leaning resonance: it was about outer space, our use and control of it, the possibilities it held for transforming life on terra firma; to get above the Earth was to enhance our ability to comprehend and change ourselves. The very act of getting above the Earth, to live and see through this perspective, made natural new forms of organization and production, the very thing Iridium represented. As with its socio-technical cousin, the Web, Iridium stood for the frontier, that social space that allowed pioneers to energetically converse with and reconstitute the culture of the status quo. And in the neoliberal moment

it was capitalism that opened further the channels of engagement between the frontier and the sedimentary life of the status quo.

Morganti, "an affable philosopher-businessman," touched on one organizing motif of the global—given intensified, practical meaning by Iridium—the erasure of distance, upending a longstanding predicate of the human condition. "This is the first civil application of the global village. This is a historic event. From the prehistoric period, from creation, it is the first time that mankind can overcome any problem of distance." As a coda to the article, the author linked this philosophic claim back to the corporation-inflected present: "Whether Iridium succeeds or fails in matching the expectations in its business plan, it has changed the world's perception of the inaccessibility of space and led the way toward creating corporations ever more disassociated from national identity and geography." This kind of talk and the *WIRED* article represented the highest tide in assessing Iridium's meaning. Within several months the venture crashed from high expectations to the ignominy of bankruptcy court.

The Problem of Culture in the Global: Universalism and Liberal Democratic Ideals Inside Motorola and Iridium

In the 1980s and 1990s, the ever-expanding reach of the media became its own story and preoccupation—in the public and in academia. Images and text circulated, through traditional media, satellites, and the Internet and Web, from developed to developing countries and in national and regional constellations of distribution, in the Middle East, Asia, and South America. As suggested in the prior discussion, these developments were one impetus to an increased interest in culture as a descriptive and analytic problem, especially as to how to understand the jostling of ways of life entailed in this media condition and in the practices of transnational business. The attention to culture—in Western academia and business—was grounded in a widely perceived problem: how to reconcile Enlightenment universalisms, particularly the foundational ideal of autonomous individuals, with respect for local cultural commitments organized on other value assumptions. It was a problem born of the running together of decolonization, with its ethos of rebalancing the power relations between developed and developing countries, and globalization's robust forces, which gave new emphasis to that challenge of rebalancing.

This section looks at the problem of culture in the global as seen by Motorola and Iridium. At Motorola, these issues were central to two undertakings. One was through an unpublished manuscript entitled "The Iridium Revolution: An-

ticipating the Human Impacts and Sociocultural Implications of Global Personal Connectivity." The other was through the production of a Motorola-published volume on ethics, *Uncompromising Integrity: Motorola's Global Challenge*. At Iridium, these issues were captured in 1997–1998 in the conceptualization and execution of an advertising campaign to promote the inauguration of the new global service in November 1998.

This broad scope of the culture problem led Motorola to make an organizational and intellectual response that was part corporate and part academic. As noted in chapter 2, the corporation, nearly contemporaneous with the decision to undertake Iridium, established Motorola University. In deploying the rubric of higher education, the university signaled an attempt by the corporation to raise awareness among engineers and managers of a particular set of problems that confronted the organization as a transnational actor and to take the initiative in organizing a response. These problems centered on the perceived centrality of process to corporate success in the competitive landscape of the 1980s and 1990s—process in the traditional sense of striving for efficiencies in manufacturing practice and in every aspect of corporate systems and day-to-day practices of doing. In the transnational frame, though, process had overlapping inward and outward aspects, reflecting the perceived closer linkages between production and consumption, between the inside of the corporation and its many points of interaction across the world. Process—how things are done and by whom—brought into the foreground the performance of corporate work in multiple "heres" and "theres" and in the increase and importance of exchanges among corporate staff and of corporate staff with myriad external actors. The focus on process was not just about streamlining structure or mechanical flows but also embraced the value systems and presuppositions of individual company workers (as varied as the many nations and communities within which Motorola operated); their relations with the corporation; and the exchanges of corporate workers with all those with whom they came into contact—everywhere. In short, process—calibrating process in the global age—also was fundamentally a problem in culture, of those pervasive and changing currents that shaped individual and community orientations to the world. Process and culture were twinned.

Culture in this historical context, though, was not presented as fundamentally oppositional—of the individual or local confronting the West or a multinational corporation. Rather, the dominant assumption (as will be discussed later) was that of the blurring of boundaries: among the individual, the corporation, and the changing field of transnational dispersions of images and consumption. Each

was distinct, but in flux, porous, and hybrid. Culture (like the market) was about the fixed *and* the mutable, of organizing presuppositions that shaped social life and their potential recombination and change. Individuals, communities, corporations, and governments might mobilize culture in particular ways to accomplish political or other ends, but in the regime of the global, culture also seemed to transcend such instantiations, to be a separate force that might be partially marshaled but also could overwhelm and resist control. The engagement of the corporation with culture was an attempt to internalize such insights, to understand it (in a fashion) and make visible its importance as a day-to-day matter as well as strategically.

Dealing with culture—however defined and conceived—thus became inextricably bound to the fundamental task of adjusting, conceptualizing, and transforming the corporation to the transnational business conditions that had taken shape in the 1980s and promised to amplify at the end of the Cold War. The founding of Motorola University, with the implied weight of the values of the academy in that last term, of a social space focused on knowledge production, marked emphatically how culture, the challenge of culture and its intimate linkage with the global, had risen in corporate thinking. Motorola, as noted earlier, had facilities and offices in tens of countries, and Iridium, with its globe-embracing technology, touched every country on the planet. Motorola University followed this corporate diaspora, establishing during the 1990s more than 100 educational offices around the world (an action perhaps akin to the rapid expansion of overseas campuses established by traditional American universities in the same period). This implanting of university educational offices was a statement of belief: that the corporation, with its boundaries, contacts, and on-the-ground intermingling with places nearly everywhere, made culture existential—a very condition of the corporation's being in the world. But how might Motorola comprehend this and relate disciplinary expertise—especially from anthropology—on culture to the practical concerns of the corporation?[41]

In 1990, soon after the founding of Motorola University, and in the same time frame as Iridium's public rollout, Chairman Robert Galvin asked Paul James Bohannan, a noted anthropology professor then emeritus at the University of Southern California (after a long tenure at Northwestern University), to bring together a few anthropologists to meet with the company's top leadership. For Galvin, the goal apparently was to explore in what ways professional anthropology might connect with this living-in-cultures condition—on the view (as reported by one of the meeting's participants) that "Motorola ought to be more cultural."[42] Bo-

hannan brought in the anthropologist Edward Hall—well known for his books *Silent Language* and *Beyond Culture*—and the Stanford anthropologist Robert Textor. Both had a keen interest in the connection between culture and technology, viewing that connection as a central problem for anthropology. In the 1960s and 1970s, Hall had focused on the relation between cultural evolution and human "extensions" (technology); Textor was a leading advocate of "anticipatory anthropology," a futures-oriented methodology for studying possible reactions and changes resulting from the (prospective) introduction of technologies into different cultural contexts. Although Textor's interest in this question was generic, his specialty was communities in Southeast Asia, particularly Thailand. Hall examined the relation between culture and technology historically; Textor projected it into the future. To Motorola, their research interests were complementary and spoke to a technology-driven organization looking to chart its way through a world perceived to be immersed in culture.

The three anthropologists met with Galvin, Chris Galvin (the chairman's son and later CEO of the company), George Fisher (then CEO), Gary Tooker (president and COO), and Bill Wiggenhorn (president of Motorola University). Joined by their spouses, they met for two and a half days and discussed "how anthropology and the cultural approach could serve Motorola's multifarious needs."[43] The meeting was organized with the expectation that the three academics might continue as consultants, but no direct further collaboration between the group and the company's leaders materialized.

But the culture issue was not to disappear. In 1991, Wiggenhorn tasked company colleague R. S. Moorthy to establish the Center for Culture and Technology as a subunit of Motorola University, with a charge to look not inward but at cultural issues on the boundaries of corporate life as the multinational company moved through the world.[44] The center would be "research-based around transcultural issues, rather than programmatic-based"—the primary focus of the university curriculum.[45] Moorthy embodied the very contours of globalization and culture the company was seeking to navigate: he came from an Indian–Sri Lankan family, living in Malaysia, and worked for Motorola in its production facility in Penang, starting initially as a line worker. He met Wiggenhorn in 1982, developing a relationship with him through the 1980s around the issues of "ethics, globalization, and cultures."[46] This focus led Wiggenhorn to bring Moorthy to the Motorola University campus at corporate headquarters in Schaumburg, Illinois. His role, which he cultivated and expanded over time, was to think about the culture problem in the present and envision its shape into the future. As part

of that, Wiggenhorn suggested that Moorthy contact Textor. After a series of intensive meetings through 1991, Moorthy and Textor collaborated on two related endeavors. One was to consider the forward-looking Iridium venture through the lens of Textor's specialty, anticipatory anthropology; the other was to look at the problem of ethics—the zones of contact between Motorola (its behavior, norms, culture) and those many locales and communities in which the company had a presence. In a world full of cultural interaction and jostling, how might a multinational pursue its aims and be attentive to cultural differences? Both projects thus were intimately bound up with the problem of culture in the era of the global. Under the aegis of Motorola University's Center for Culture and Technology, one project produced an unpublished manuscript; the other, a published book, *Uncompromising Integrity: Motorola's Global Challenge*.

The "Iridium Revolution" Manuscript

In 1992, Textor and Moorthy began work on an anthropological assessment of Iridium. By 1994, they had a draft, initially entitled "'What Hath God Wrought?': Anticipating the Human Impacts and Sociocultural Implications of the Iridium Revolution," soon to be retitled with more modesty, "The Iridium Revolution: Anticipating the Human Impacts and Sociocultural Implications of Global Personal Connectivity."[47] Over the ensuing four years, Textor undertook more than 20 additional revisions. The two proposed titles for the manuscript give some indication of the core of the effort, which was to look out from Motorola and this folding together of corporate, academic, and anthropologic perspectives. As an embodiment of period tensions, the manuscript is worth analyzing in detail.

The intellectual center of the study was the core liberal and neoliberal claim: that idealized Enlightenment individuals and the market mutually produced an optimum social order. This claim was not overtly, ideologically advanced; rather, it was assumed. Iridium, in its globality and in its deployment of a technology—a communications technology—that facilitated individual control, choice, and action, energized both parts of the equation. The grandiose phrasing of "what hath God wrought" thus spoke to the perceived scale and foundational import of the more modestly expressed "human impacts and sociocultural implications of global personal connectivity." In the manuscript, the accomplishment of fusing the global and the personal, through the market, was presented as epic. But in what way? It was not merely a large-scale technical and business accomplishment of the present, but a point of departure for a process of sustained transformation in which the global would empower the individual as autonomous actor, to rise

in independence and agency. The actualization of the global through Iridium performed a critical function: it provided a genuine field of action for the individual to be fully autonomous, to counterbalance and reorganize the many forces of the local, including family, community, and nation. The global, as the manuscript envisioned it, was the lever to reposition the local, to enable an individual to be in it and out of it at the same time, to be imbued with the culture of a time and place and to be a universal Enlightenment citizen. It was to create a negotiated balance between the global and the variegations of culture and politics inherent in many locals—with the neoliberal global preeminent, making Enlightenment-style individual agency the critical value system allowing for cross-cultural connection and the establishment of shared interests. Over time, Textor argued, such a dynamic implied a radical change in the human condition. The document thus looked to the future, a conceptual space in which one could imagine equality among all market citizens, not to conditions of the present.

Textor, as an academic anthropologist, sought to ground this effort in a methodology he had been developing for more than a decade. The method, Ethnographic Futures Research (ERF), began to take shape in the mid-1970s, when Textor considered whether he might "use ethnography not as a way of studying past cultures or present cultures, but as a way of studying future cultures. The difference is obvious. When you're describing a future culture that's an exercise in imagination. There are no future facts. But why not try?"[48] With this insight, he embarked on an intensive reading of the futures literature, which as a subspecialty had emerged in the mid-1950s, with the RAND Corporation, as part of its Cold War research, serving as a critical node. Of particular interest to Textor was the Delphi Method (initiated by the RAND mathematician Olaf Helmer), which focused on forecasting science and technology developments, a problem that seemed pressingly natural given the US Cold War policy of stimulating continuous innovation. The critical element of Delphi was to conduct detailed interviews with experts who had in-depth knowledge in a subject area, and thus were presumed to be best positioned to extrapolate from present to future conditions. The interviews would be assessed, and depending on the degree of coalescence among expert judgments, one might regard particular outcomes as more or less likely.[49] Textor saw himself building on this work, but adding a new conceptual orientation, to make the forecasting of culture, of social structure and values, part of his research domain. As he noted, EFR is about the use of both futures and cultural literatures: "as a method, it is unlike most futures research, it is both futures

and cultural. It is ethnographic, which means that we're looking, when we think of alternative futures we're thinking of a total way of life."[50]

In 1992, Textor apparently broached to Moorthy the idea of doing "a culturally sophisticated futures-oriented study of Iridium." But the study would have to depart from EFR methodology. No funds were available and thus the study could not be executed through Textor's usual protocol, which included training interviewers, conducting interviews, and then compiling and assessing results. Textor proposed, instead, that he interview himself and Moorthy. The goal, too, was perhaps different from what Textor had envisioned for EFR: to "prepare something that the company brass in Motorola, and hopefully the company brass in Iridium, could use to make Iridium a better product, a profitable product, and one that accorded with our own ethical concerns." It sought to bring comfortably into the same frame profit-making and ethics, and more particularly the conjunction of these two outlooks in the context of local-global jostling in the 1990s. The tension in that jostling was to reconcile the long shadow of colonial legacies, the aspirations of developing countries and areas, and the role of the market as manifested through an enterprise such as Iridium. It was a tension between means—the processes and values of markets—and ends—a complicated juxtaposition of greater equity in global power relations and respect for locally manifested culture.

This section references the version of the manuscript prepared in 1994, the moment when international investments (including those from Canada, China, Italy, Japan, Russia, Saudi Arabia, Taiwan, Thailand, and Venezuela) and the advance of engineering efforts had given the project political and technical solidity. To manage the tensions sketched above, the manuscript shifted the focus in an important way. In the title "Iridium" is in the foreground; in the manuscript narrative, though, "Iridium" as a term is a placeholder for a broader concept—"global personal mobile communications." As the authors noted, their task was "to explore, and stimulate others to explore, what might happen to the way people around the world will live, when global personal connectivity becomes a reality. We define 'global personal connectivity' as that situation where in principle any person, anywhere, anytime can communicate with any other person without either knowing where on Earth the other is."[51] This change in referent—in which Iridium meant Iridium *and* a wider, generic technical and market capability—shifted the ground of the manuscript (a shift indicated in Moorthy and Textor's revision of the title and subtitle of the manuscript noted previously). In a narrow vein, this definitional move was to distinguish Iridium from business competitors

such as Globalstar that did not plan to offer global coverage. In a broader context, though, this repositioning sought to draw attention away from Iridium as a business and highlight "global personal mobile communications" as an anthropological problem. But it was not just an academic problem for anthropology as a discipline but also for the corporation—the interests of discipline and company were entwined. The manuscript was to help Motorola "visualize concretely the possible human impacts of Iridium, let alone its longer run implications for the social structures and cultural value systems of the world's various peoples."[52]

Iridium thus was just the vanguard of a larger, more profound techno-cultural world in the making and in need of contemplation through the tools of anticipatory anthropology. For Textor and Moorthy, each of those modifiers ("global," "personal," "mobile") that preceded "communications" mattered. It was through the "global," of putting each and every local into contexts broader than itself, into contexts of markets and information flows, that localities would renegotiate their boundaries and their values in a changed world. And "personal" and "mobile" were the nodes around which such renegotiation would likely occur by putting (theoretically) more power, control, and efficacy in the hands of individuals—in short, to enhance their agency. It was these very characteristics and potentialities of Iridium (broadly construed) that warranted, for the authors, the use of "revolution" as a characterization of the change that might ensue.

Such abstract sketches of change—complex cultural change located in the future—properly seems fraught if not fanciful. But it did have grounding and legitimacy as a question and a problem. Recall Textor's anthropological research in Thailand; Moorthy's personal biography; the investment of Second and Third World states and corporations in the project; the cultural shifts associated with cell phone use; the prospect of even more ambitious planet-embracing projects such as Teledesic; and, not least, the then nascent boom of the Web (importantly different—less mobile, less ubiquitous—but related to the "global personal mobile" condition that was the focus of the manuscript). The manuscript, though, took up the burden of making a more specific case for change.

"The Iridium Revolution" consisted of a preamble that sketched Iridium as a technical and political system and the need for an anthropological appraisal of the broader global mobile personal phenomenon it was spawning. The bulk of the manuscript was a series of propositions, 77 in number, echoing the atomic number of the element iridium and the original design configuration of the satellite constellation. Each proposition was a single, declarative sentence indicating the change the authors envisioned, followed by a short narrative arguing for the

plausibility of the claim. But how might such a collection of propositions make a case for revolutionary, large-scale local-global change?

The authors had a two-part analytic strategy, connecting geography with the agency of individuals. Their geographical parsing relied on a rough (as they admitted) correlation of technology with social life, using global variations in density and availability of transportation and communications capabilities to distinguish different political-economic conditions. Their template was quaternary, demarcating areas as follows: high-transportation / high communication; high transportation / low communication; low transportation / high communications; low transportation / low communication. Examples of each, respectively, included Germany, Hungary, modern mineral prospecting camps in desert or arctic regions, and northern Laos. The analysis, along this axis, offered a blunt gradation of First, Second, and Third World conditions, with ad hoc instances of industrial or scientific practice, indicators, primarily, of the First World's geography-spanning interests.

As a taxonomy, it was meant to bring out the "friction of distance," a prominent trope of the globalization literature in the 1980s and 1990s (and recall its invocation by Giuseppe Morganti in the previous section).[53] Such friction, in the authors' eyes, was a critical problem, inhibiting the possibility of uplifting individuals everywhere as rights-bearing actors. To be endowed as a universally defined self was to be friction free—or more precisely, to be able to negotiate and choose one's "friction-ness," to be an agent, not a political or cultural subject. The global as a stage of action, and globalization as a lubricant of the spatial, was the context through which the individual could, by choice, revoke, alter, or reaffirm the local, and thus was the crucial guarantee of this sought-for condition. The focus on transportation and communication highlighted the materiality of the global, of its constitution through infrastructures, and of the mobility these enabled, as either actual movement or action-at-a-distance. It was such mobility that provided leverage vis-à-vis the local, and allowed new possibilities for comparison, negotiation, contestation, or the marshaling of resources from a broader geographic sweep. Such enhancement of the individual on such an extensive scale needed market-driven globalization and, more especially, individually centered, totally planetary communications. These were the only tools extant—not national or international government—that might diminish friction and thus empower the individual, particularly in those regions of the world in which Western values were not the organizing basis of society. But, of course, the market and corporations were not, in their animating purpose, agents of eq-

uity and empowerment. All consumers were not equal, nor were they possessors of meaningful power in their economic transactions, and, indeed, many on the planet were not even consumers at all in the Western sense.

Textor and Moorthy were aware of this tension—of the market as an imperfect instrument for political transformation and of radical disparities in social and individual standing. This geographic taxonomy, then, was married to a taxonomy of users, thereby turning the manuscript to issues of culture and anthropology. And with the manuscript's slant toward Western concepts of the self, it was not surprising for this taxonomy to be centered on the relative modern-ness of the users—moving from "persons of distinctly modern outlook who are based in the modern industrial world" to "persons of distinctly non-modern outlook who live and work in their native area . . . Example: an elderly village headman in highland Morocco."[54] The manuscript notes that persons of the latter type, "while vastly more numerous in the world as a whole, will generally not be early regular adopters, because of poverty and lack of any felt need for regular wireless telecommunication . . . [but] especially the younger among them who happen to be ambitious for an urban standard of living and a cosmopolitan lifestyle will put Iridium to all sorts of new political, economic, social, and cultural uses. Some of these will seem bizarre to more conservative local people, and lead to various types of surprise, pleasant and unpleasant."[55] Though this statement entwines several threads, it assumed the already powerful force of global markets of which Iridium was an amplifying and reinforcing element and assumed the attendant disparities of wealth and control in juxtaposing "modern" and "non-modern" locales and individuals.

Embedded in the example above, too, was not just a classification of users but also a scenario of the processes of use—and their potential consequence: the very purpose of the manuscript. The propositions in the manuscript drew on the overlapping taxonomies and assumptions above, but were given particularity through another template that analyzed process: who or what would communicate, what messages, to whom or what, using what modes (Iridium had fax and paging as well as voice capability), and with what intended effects?

As an exercise in anticipatory anthropology, the analysis also embraced "unintended" effects, which might induce, in the authors' judgment, shorter- or longer-term, narrower or broader, changes. Taking the example of the non-modern Moroccan highlander cited in the manuscript, one can see how this template of process questions could at least bring forward the complexities of local-global interaction and, more specifically, of the interrelations among tech-

nology, sociocultural orders, behaviors, and attitudes. The manuscript sought to highlight, but not explore in depth, the way Iridium might change the "way adopters work, save, participate, cooperate, compete, innovate, manage, produce, play, flirt, or express their individuality," as well as how such a communications capability might alter individuals' attitudes toward the dominant social order, "to feel about, evaluate, their status quo and their chances for changing it." In framing change in this fashion, the authors' intellectual stance was not that of "radical technological determinists . . . rather [it was to] look to a combination of technological availability and sociocultural propensity."[56] The change they sought to project was not uniform, but particular to place and condition, albeit situated and defined by the ambient presence of transnational markets.

Textor and Moorthy were attempting to reconcile a crucial tension: a belief in beneficial possibilities of the market and the ethical problems posed as that vigorous agent moved into and through a variety of cultural spaces, touching the fine grain of individual and social life. As Textor noted in an interview: "As somebody not from the business community, I'm primarily ethically driven, but I realize that in a capitalist system, a company like Motorola or Iridium has to make a profit, and you know, that's a fact of life, and if they serve the public honestly and well, they're entitled to a fair profit. I don't have any problem with that. But my own motivation is primarily, how can this new gadget really help people that need help?"[57] That, of course, was the disjuncture: though the market or Motorola might provide help, it was as an *effect* of making and selling products; their primary motivating rationale was rather different, profit. Textor, whether by intention or happenstance, used the idea of the future, and its corollary of anticipatory anthropology, as grounds for shaping an intellectual, yet-to-be-realized accommodation between the market and ethics. In a section entitled "The Ethical Need for Anticipation," the authors averred that Iridium-type capacity would "sooner or later" facilitate "profound changes in the way the people of the world will live," stimulating

> the formation of a vast array of new skills and values, and new roles and goals, and thus, in the longer run, significantly transform various aspects of the social structures and cultural values systems within which hundreds of millions of people will live. We believe that most of these changes can be positive and liberating for the great majority of the world's people. To be ethically and intellectually honest, though one must remain mindful that that there could be unintended negative effects, and that proactive Consortium [the Iridium in-

> vestors] and public policy can help to minimize this negative potential, while maximizing the positive.[58]

Textor, more broadly, set the manuscript and his disciplinary interests in the context of the field of futures studies, looking to works such as *Foundations of Futures Studies* by Wendell Bell, as exemplars.[59] Textor noted: "his [Bell's] whole volume two is essentially adding an ethical dimension to futures thinking. We're not just trying to predict the future, we're trying to design it, and we're not trying to design it for the sake of designing it, but for the sake of a more ethical, a more responsible future world if you will."[60] Iridium, as shorthand for personal global mobile communications, was, from Textor and Moorthy's perspective, fertile means to "really help the people that need help" in a market world that bore the stamp of a longer history of global inequities. This particular technology and the attributes it embodied put power in the hands of individuals, power that derived from communications as an abstract democratic good and through those modifying, individual-enhancing adjectives ("global," "personal," "mobile").

But as the quote above suggests, such agency alone probably was not enough to realize Iridium's potential beneficial effects as a liberatory catalyst; proactive, compensatory policy by Iridium as an international collective of states and corporations and by international bodies such as the United Nations would likely be required. An implausible thread ran through the manuscript: that Iridium, as a business enterprise, as a unique end-of-the-Cold-War creation of states and companies representing First, Second, and Third Worlds, as former antagonists uniting under a market banner, would aim to both be a profit-making entity *and* serve as a not-concerned-about-profit instrument of public good. That in resembling a mini-"united nations" in composition, but not in aims, it would take up, in some measure, the common weal as an animating purpose. The assumption seemed to be that the particular histories embodied in Iridium, and the historical moment that made such conjoining possible, transcended the typical conception of a corporation and of the market.

The authors suggested, for example, that "the values of Consortium Culture will lead it to offer certain emergency health and safety services to everyone in the world regardless of ability to pay . . . especially in the early years of the Iridium Era, and especially in less affluent nations, we envision a possible Consortium policy that would supply Iridium phones and service, at a sharply reduced rate or even free, to upcountry polyclinics that lack terrestrial telephonic communication . . . a service that would be deeply appreciated by millions of villagers around

the world and by their governments. Such a *pro bono publico* gesture would serve to demonstrate a set of Consortium values that are a humane blend of a profit and a service orientation."[61] These public good values might well be pushed even further. As a global high-technology service, Iridium's presence in less-developed regions could be socially and economically disruptive: some would use it, some not; some would be able to afford it, some not. There would be winners and losers, the authors noted, with the latter finding their existing economic roles erased. But in a globalized world in which corporations had become both beneficial and destructive forces, new social, transnational compacts might be required. During the twentieth century, the provision of social safety nets had "typically been viewed as the responsibility of government. It is worth asking ourselves, however, whether it could now be appropriate to ask corporations to assume part of this role. While one might be inclined to answer Yes, that still leaves open the question of as to just how one can expect Corporation X to allocate, say one percent of revenues for ten years to a safety net fund. . . . It is not clear that any international entity exists with the legal authority or political will to create this mechanism."[62]

This intellectual positioning led to the propositions, which were divided into "early impacts on individuals and small groups," "early impacts on governments and large organizations," and then the broader "long-run sociocultural implications of Iridium." In the first set, the theme of empowerment was central, arguing for Iridium's capacity to enhance an individual's control over the environment. More specifically, the propositions, in keeping with the authors' effort to problematize the modern, non-modern, and ethics, took as their focus "the less industrialized areas of the world, and on people in villages and small towns in both the 'Third World' and the former Communist nations." In these geographic and cultural sites, "we see many of the most profound effects as likely to occur there. One must bear in mind that half of the world's population live more than two hours away from a telephone; and that in Russia alone, some 50,000 villages are still without basic telephone service."[63] And in the vein of modernization thought in the 1950s and 1960s, Iridium, too, might allow these areas to overcome the absence of land-based telephone infrastructure and reap the benefits of wireless communications.

This outlook informs many of the propositions. Proposition 5 offers that "Iridium will provide totally new opportunities for illiterate and semi-literate persons to communicate across great distances." Proposition 11 forecasts that "greater safety of movement will have a special significance for women, in making possible

new behavioral options," especially in conservative cultures in which "women—especially if young and single—are expected not to be away from home after dark." With Iridium, "departures from traditional standards might be allowed." With such fusing of technology and local culture, the authors foresaw "a general process in which departures from such conservative norms will become more common, and give rise gradually to changes in the norms themselves."[64]

Several propositions also covered the relationship between individuals and the market. Proposition 14 suggested that Iridium "is more likely to drive sudden increases in wealth or income, than in power or influence." It will "have the net effect of expanding economic opportunity—assuming a reasonably free and fair set of rules for economic competition in the world, as well as in particular market areas. (This seems plausible, given the strong current worldwide trend in that direction). We see economic structures as more malleable than political structures." Indeed, the next proposition saw such a shift promoting change in less-developed areas, enabling "many previously isolated producers to fine-tune and fine-time their responses to the market, and thereby gain new business opportunities," making it possible "in some cases [to] become an important factor in altering the structure of a local or regional economy."[65] Such change in business practice also could be consistent with reinforcing the value of kinship ties across geographically dispersed diasporas. Female entrepreneurs will be empowered "because culturally they are not as free as men to move about unescorted or unaccompanied, or to venture far away from home, especially after dark."[66] The effect of such an enhancement of power for individuals and localities would be to subvert existing structures of "inherited wealth, social privilege, or political connections."

As with most communications tools, Iridium's uses were conceived to extend beyond political-economic applications and to enter into the messy realm of everyday life. "Some regular adopters will be motivated in part by a felt need to relieve loneliness and boredom, and to seek pleasure," including pornography, noting that "it seems virtually inevitable that merchants of telepornography will . . . be . . . as avid to utilize Iridium as they have been in the case of wireline—and far more so if and when Iridium adds a visual mode."[67] Such flexibility of use, too, "will cause some short-run change, anxiety, and stress in the realm of sexual behavior and mores, because it will make some girls and women more available to communication . . . freer to receive wireless love messages than [their precursors were] to receive letters," and it "will be used by gays and lesbians, who, in many cultures, have an even greater felt need for covert communication."[68]

As mobility was a critical precept for the authors and Iridium as business, the authors noted that the service would tend, for moderns and non-moderns, to make it "safer for many individuals to widen the range of their movement." Although globalization as a pervasive abstraction distinguished the 1990s condition, the particulars on the ground were anything but: "throughout the world there are tens of thousands of dangerous areas that outsiders are reluctant to enter, even when they might have important economic and social needs to do so. Some of these areas are in the transportationally least accessible areas of the world, such as mountain, desert, jungle, or tundra areas. Others . . . are not isolated, but nonetheless dangerous—such as many inner city areas in large urban centers."[69] Iridium thus, for all users, had the potential to lessen risk and anxiety of those who were mobile and entrepreneurial, to smooth the way for the global. This would be a critical theme in Iridium's corporate advertising campaign in 1997–1998 (discussed later in this chapter).

These various themes and modes of empowerment inexorably framed a central thesis of the manuscript: of the self—not the social—becoming the critical reference point for politics. This was expressed succinctly in one proposition: "In general, regular users of Iridium will shift toward perceiving themselves as autonomous individuals"—that is, of course, as autonomous actors embedded in markets.[70] This already was the condition in the West, and, now the authors projected, would become the state of affairs in places and cultures in which this presumption was not (yet) regnant.

But such autonomy brought, potentially, a range of effects, in addition to those already described. Changes in business and administration, with the turn to markets, would bring stress, but they also would "motivate more and more people to learn how to prepare for, and to make, rapid decisions." With autonomy, too, would come a new critique of existing political orders. Some "will use Iridium in efforts to evade authority of government—for purposes of human liberation, freedom, and dignity," and some, less noble, will seek "to evade the authority of government—for socially destructive purposes," including drug smugglers, despoilers of protected environments, and spies (propositions 32 and 33).[71] The combination of a planetary technological capacity and its ready availability to rights-bearing individuals, the authors argued, would lead to moral and political accountability on a global scale, countering the power of the local or the nation to control disputes. The authors suggested: "Violations of public policy and international morality will be easier to document and report, which will have significant effects on world opinion, and hence ultimately on law and public policy."[72]

Such changes that built out from an invigorated sense of self, empowered by technical capacity and access to markets, to ever-broader scales of action were explicitly presented in the section of the manuscript "Long-run Sociocultural Implications of Iridium." As the preceding summary suggests, the combination of individuals, markets, and technology would recalibrate the local and global dynamic, especially in the direction of giving individuals the leverage to use the global as an instrument to reshape the conditions of the local. The authors foresaw that "as time goes on, and the process of evolving a global polity proceeds, the distinction between national and international affairs will attenuate." That process will be driven by the expectation "that persons formerly excluded from participation will now *know* [emphasis in original] that their participation is technologically possible. . . . More and more of them will press to be included in the participation loop."[73] As a concomitant of the erasure of boundaries, Iridium would, as a long-run effect, stimulate a decentralization of economic, political, and social life. The technology, they argued, subverted a history of centralization of communications infrastructure, and thus those longstanding center-periphery structures within a state or internationally, and, instead, encouraged periphery-periphery contact and relationships.[74]

As a long-term effect, the creation of autonomous individuals would culminate in an "increase in the cultural valuing of individualism" and politically the favoring of "democratic rather than authoritarian" regimes.[75] In total, the effects of an Iridium-like capacity promoted an Enlightenment, universalist conception of life. Yet, despite the power of markets and Western models of consumption, it would not, the authors believed, lead to homogenization of local culture. Rather, "Iridium will be a force for the preservation of cultural *heterogeneity* [emphasis in original]." The very flexibility and ubiquity of the new communications would serve the "millions of people . . . actively striving for the preservation and revivification of symbols that will give strength and satisfaction to their sense of ethnic identity," many of whom "often have negative feelings toward the culturally homogenizing effects of mass industry and the mass media."[76]

The final proposition, number 77, brought this balance of "different but the same" to a close, suggesting that the service will "tend to facilitate a stronger orientation toward the *entire* world community," but framed in terms of autonomous individuals and their revolutionary transformation, by making their contact "with more people around the world possible and convenient, will have the long-run effect of establishing worldwide understandings, loyalties, and identities."[77]

"The Iridium Revolution" was a testament to post-1970s neoliberal democratic thinking, fusing such a framework of thinking with the project in strikingly explicit terms. The manuscript, though, represented the formal expression of a sentiment that coursed through the project broadly—at Motorola, by managers and workers, at Iridium the company, and in media accounts, as covered earlier in this chapter. This reflected the distinctiveness of the first several years of the post–Cold War moment, with its utopian sense of possibility and the way in which Iridium as a big, literally global undertaking struck and reinforced the period's most prominent themes. It, more than competing satellite projects, stood as such a symbol in media coverage of this business-cultural phenomenon. The political literature on the linkage between markets and liberal democratic ideology had been building since the early 1970s and was reaching full flower at Iridium's inception. Francis Fukuyama's "The End of History?" essay in 1989, discussed previously, captured the belief that with the end of the Cold War, the market as an engine for the production and consumption of goods and liberal democracy as a political system were in natural alignment and the means to greater social good on a global scale.[78] The manuscript, with its anthropological analytics, made this case, too, reinforcing the idea of the sovereignty of the individual as a political *and* a cultural actor. The latter claim was to bring forward the presumed remapping of individual inner life, of beliefs and presuppositions, *and* its consequences for the transformation of local, state, and transnational conditions. It was, through the lens of the authors, revolutionary.

But why did the authors—one a Motorola manager, the other a professional anthropologist—make such an effort to conceptualize, compose, and present to Motorola leadership the meanings of a business enterprise? It was that moment's deep assumed connection between technology (at least of the new communications sort) and politics, and the associated implications for individuals as political subjects. This insight motivated the manuscript's authors. What, indeed, were the ideological and political implications of a technology and market-organized effort that embraced every person on the planet? In the postcolonial 1990s, the conceptual starting point could not be the decades-gone-by pairing of the imperial citizen and the colonial other. The question of how to position the newly created citizens of a world market to "First World" market citizens was the critical tension in the authors' analysis. In offering a corporate-grounded narrative, though, their tendency was to put a positive cast on the challenges of grappling with historically generated inequities between center and periphery, or those

then current imbalances between economically developed and undeveloped regions. As such, they looked to the future, a conceptual space in which one could imagine the fashioning of equality among all market citizens.[79]

Uncompromising Integrity and Ethics in the Global

But the manuscript effort did not complete Textor and Moorthy's collaboration. Under the umbrella, again, of Motorola University's Center for Culture and Technology they returned to the problem of corporate life in the global era, of juxtaposing Western and local values, of ethics. But this time the focus was on the present, not the future, and on Motorola as a transnational corporation, not Iridium. As already noted, as a Fortune 500 firm it was deep-pocketed and well-connected politically, at home and internationally, with tens of factory and sales sites around the world. It had the ability to create favorable conditions for its presence in these many and varied locales—it had power. But as the creation of Motorola University and its Center for Culture and Technology suggested, the corporation had come to see, beginning in the 1980s, that as a transnational entity it needed to take into account the problem of operating—as producer, consumer, and seller—in these different contexts. In short, as the manuscript suggested, it needed to find accommodation among issues of identity, selfhood, beliefs, and contexts of meaning—it needed to engage culture as a business problem. This became more urgent with the turn to globalization, in which neoliberal and post-colonial interests partially overlapped, each seeking in different ways to elevate the individual as actor. Culture thus was perceived as central, not tangential, to the corporation of the 1980s and 1990s. Motorola, with its multiple geopolitical presences, as the instigator of a literally planetary project, incorporating flesh-and-blood actors from around the world, dramatically confronted the problem of culture—local, global, multiple, contesting, unruly, not readily controlled, as a lived fact and the source of symbol-making and meaning. In consequence, it needed solutions, especially when different cultural perspectives led to differences in expectations and behavior, and thus, potentially, misunderstanding, dissonance, or conflict. These might occur at numerous friction points—internally, at the boundary, or externally—that arose as a transnational company conducted its business.

Moorthy led a concerted corporate response to this set of issues, with Textor as a collaborator and Robert Galvin, the company's chairman emeritus, as a critical supporter. Galvin, who led Motorola as CEO from 1956 to 1986, retained a mid-century view of a corporation's social responsibility.[80] He was instrumental

in establishing Motorola University in 1989 and in 1991 published a personal and business manifesto, through Motorola University Press, entitled *The Idea of Ideas*, which emphasized the importance of ethics in corporate life.[81] The result of Moorthy's effort, concurrent with his work on the "Iridium Revolution" manuscript, was a 1998 book entitled *Uncompromising Integrity: Motorola's Global Challenge*, co-authored with Galvin and published by Motorola University Press.[82]

The "challenge" of the subtitle was to manage the confluence and frictions of transnational business activity and local culture, and to provide Motorola managers, in particular, but employees generally, a practicum on how to identify, confront, and resolve ethical differences. The path into this challenge was the concept of culture, which in the age of the global was seen as the critical ground on which differences in value, behavior, and meaning were manifested, and thus the basis for creating a framework for ethics. The book's narrative provided definitions of culture and related concepts that showed it as a structure, but varied in place and time, and as a process—national culture, subculture, host culture, and then, enculturation and the transcultural. Two key additional notions situated the discussion in the corporate context: "Motorola culture" and "home culture." "Motorola culture" made clear that the organization embodied its own assumptions, ways of doing, and codes of meaning, derived from its own history as a company with origins in the Midwest and as a capitalist institution (fig. 4.1). "Home culture" referred to individuals and their geographic and social attachments. As a collective category, embracing many different individuals and contexts, home culture was mutable, in flux. Employees hailed from many localities around the world, and as a multinational the corporation always was operating in someone else's backyard. Each was readily subject to change. Culture was something around which a company had to define itself (Motorola culture), to assert its own values and modes of meaning-making, an especially important act when operating on a transnational scale (fig. 4.2). Yet, in the global age "home" was complex, mobile, reflective of the world's many diasporas, of people, individually and en masse, following the flow lines of capital. Home inhered in individuals even as they moved (with Motorola employees themselves an example) and in those places from which they came. Motorola and home cultures were likely different, if not oppositional, and yet profoundly interpenetrating.[83]

The core of the book, a series of pedagogical case studies, made this clear, probing the frictions that inhered in transnational business practice. These cases sought to make company managers and employees aware of particularity and difference, of the "challenges" to Motorola culture and its sustenance as home cul-

10 **Chapter One: Introduction**
The Ethical Values of the Motorola Culture
The Motorola Culture's Midwestern American Roots
The Motorola Culture in Its New Global Context
Good Ethics Will Always Be Good Business
Motorola's Willingness to Learn from Other Cultures
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Ascertaining the Facts
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Ideals
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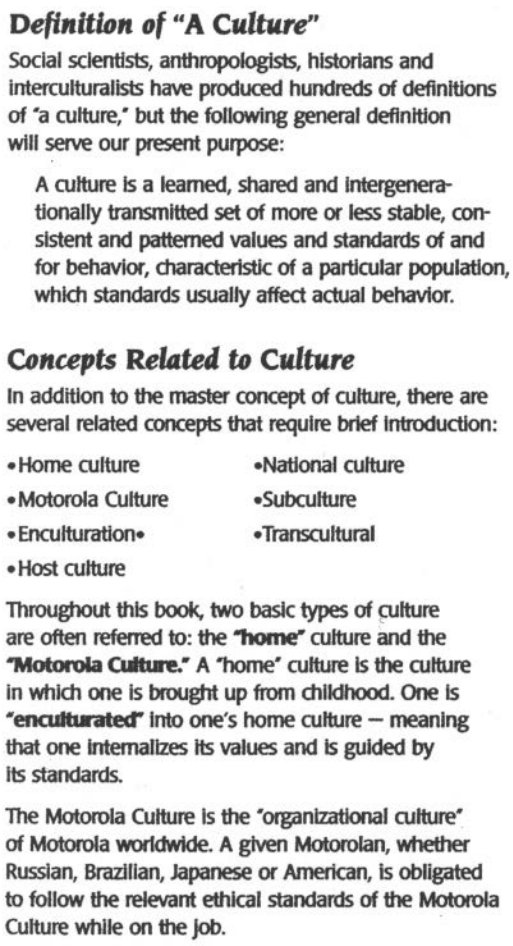
Seeking Imaginative Solutions
Seeking to Prevent Recurrences

Figure 4.1. Excerpt, *Uncompromising Integrity: Motorola's Global Challenge.* Courtesy of Motorola Solutions

tures inevitably entered corporate life. For example, one case, titled "Uncompromising integrity and egregian justice," narrated a scenario at a Motorola facility in a non-Western nation in which an employee "steals company property of minor value and manager reports employee to police, who then execute employee summarily." The themes to be discussed were "differing cultural and legal standards regarding fair punishment for a crime" and "individual dignity." Another brought the friction of the global to the United States. In a case entitled "profits and people," a "manager of a Company Task Force concludes that positions of three TASK



Definition of "A Culture"

Social scientists, anthropologists, historians and interculturalists have produced hundreds of definitions of "a culture," but the following general definition will serve our present purpose:

> A culture is a learned, shared and intergenerationally transmitted set of more or less stable, consistent and patterned values and standards of and for behavior, characteristic of a particular population, which standards usually affect actual behavior.

Concepts Related to Culture

In addition to the master concept of culture, there are several related concepts that require brief introduction:

- Home culture
- Motorola Culture
- Enculturation
- Host culture
- National culture
- Subculture
- Transcultural

Throughout this book, two basic types of culture are often referred to: the **"home"** culture and the **"Motorola Culture."** A "home" culture is the culture in which one is brought up from childhood. One is **"enculturated"** into one's home culture — meaning that one internalizes its values and is guided by its standards.

The Motorola Culture is the "organizational culture" of Motorola worldwide. A given Motorolan, whether Russian, Brazilian, Japanese or American, is obligated to follow the relevant ethical standards of the Motorola Culture while on the job.

Figure 4.2. Excerpt, *Uncompromising Integrity: Motorola's Global Challenge.* Courtesy of Motorola Solutions

Force members should be eliminated, and that a U.S. plant should be closed and moved overseas." Topics to be assessed were "Right-sizing that shifts production out of the country. Fairness. Respect for individual dignity. Employee loyalty." In both examples, "Motorola culture" and "home culture" were put in play, indicative of the global's wide-ranging thrusting together of value systems. More particularly, they highlight a feature of the post–Cold War 1990s: that the individual and market efficiency were critical, if often conflicting, points of departure in constituting a vision of the global.

Underlying such analysis was an assumption about globalization as a condition: that its very processes disassembled or recast boundaries of all sorts, from the political to the inner life of individuals. *Uncompromising Integrity*, like the "Iridium Revolution" manuscript, made an important, implicit claim about the nature of the global world. The processes of the global, their unmaking of prior boundaries and understandings, unsettled the corporation as well as multiple communities and individuals. To be sure, the latter did not have the same resources to manage and respond to such change. Yet in both these corporate products—the manuscript and the book— one can see the company as recognizing limits to its power of control, to see the world as full of streams and locales of meaning and ways of doing that were like facts of nature, with which it might negotiate or adapt to but not change in other than marginal ways.

It reflected, too, the elevation of the individual in the market world—but still unsure of how to position the rights-bearing individual in the corporate context. The individual was an inextricable part of the equation, an entity to be accounted for if globalization was to be well oiled—at least for corporations that assessed the condition of globality as Motorola did. This situation was different from Henry Ford's vision of paying workers a sufficient wage so they could purchase the automobiles they made, or Lizbeth Cohen's insights on consumerism as a form of political participation.[84] It was to think of the individual as a spatial actor, an actor integral to a condition in which different spaces, and thus different cultures, had to be reconciled. One practical manifestation of this, made several years before *Uncompromising Integrity*, was to create "regional Ethics Committees," to help address culture issues from local perspectives rather than from company personnel sitting in Schaumberg, Illinois (the practice prior to the regional committees).[85] Such thinking represented a position that was pragmatic, but also infused with universalistic idealism, to believe that the individual was better to include than ignore in fashioning a transnational political and moral order built in and through the market. At root, too, it reflected a claim on the commonality of human values across cultures, a belief, as Wiggenhorn put it, that "we appreciate differences in culture, but we trust those differences, at their core, are similar in the values and principles that we [Motorola leadership] hold sacred."[86]

Uncompromising Integrity's preoccupation with culture—perceived as variegated and everywhere, in specific geographical places, in institutions, including Motorola, in individuals, and pulsing through the many channels of the media—had a corporate history. It encapsulated more than 15 years of high-level managerial attention to the global. It led executives in the late 1980s to create a hybrid

academic-corporate institution—Motorola University—to engage and comprehend the fauna and flora of culture-world. This book was a product of that and, as noted, was a Motorola University Press publication. Lest the Motorola case seem quirky and isolated, it exemplified, as descried in chapter 2, a larger trend: over a decade, from the mid-1980s to the mid-1990s, more than 1,000 corporate universities were created in the United States—all of which were a response, in one fashion or another, to the perceived challenge of culture, identity, and meaning-making in transnational business practice.[87]

The biography of Moorthy, the lead author, made concrete some of the issues of identity and politics embedded in these developments. His professional life at Motorola became one of conjoining and assessing his origins in a place with a specific history, one that entangled colonialism and the new globalism.[88] He created a way to marry his interests with Motorola's culture preoccupation, playing a major role in Motorola University as the creator of its Center for Culture and Technology. In a small, but direct way his biography encapsulated the period's simultaneous elevation of the importance of the individual, the corporation, and transnational markets as measures of the good and the attendant messiness that such juxtaposition entailed.

Advertising the Global

Return to this chapter's opening and the first block quote, "Freedom to communicate: Anytime, anywhere." Read alone it could be a catchy aphorism, encapsulating the fundamentals of an Enlightenment ethos: of a rights-bearing self, independent in action and thought, confident, mobile. In this regard, it was in league conceptually with the aspirations of the "Iridium Revolution" manuscript. But as the supporting text highlights, there were critical differences. The advertisement was about the present—not the future—reflecting the need to promote and sell a product in the present, to define Iridium's market appeal as the service rolled out in the fall of 1998. It also signaled the distinct (but connected) roles of Motorola and Iridium as businesses—that the latter had primary responsibility to make the service succeed as a profit-making enterprise, to cultivate and acquire customers. It was in that charge that the advertising slogan sharpened the key questions—for whom was the service intended and who could afford its hefty (even by First World standards) cost?—and displayed the gap between the project's universalist language and images and the realities of the marketplace.

In the fall of 1997, the Iridium advertising campaign began to take shape. The venture, announced by the media in 1990, had been in the public eye for

years, standing as an exemplar of the post–Cold War moment, a statement about markets, entrepreneurship, the global as a condition of 1990s life, the role of new communications technologies in reordering the cultural and political landscape, and, not least, the seemingly enhanced prospects for liberal democracy. By mid-1997, Iridium was closing in on its late 1998 goal of achieving commercial operation—satellites were pulsing out of the factory; launches in the United States, China, and the Kazakhstan were placing them into space; and, in the financial enthusiasm of the mid-1990s, Iridium had had a successful IPO, creating a cadre of followers of its common stock. But a large challenge remained: the conjoined task of creating a network of providers to reach potential customers and to inform and entice such individuals to make a purchase of an Iridium phone and service. This discussion focuses on the latter—the advertising campaign—organized and created from the fall of 1997 through the spring of 1998, and then rolled out in early summer of that year.

From the beginning, the campaign embodied the seemingly strange conceptual and practical marriages of the Iridium project. In organization, the campaign mirrored that of Iridium as a whole: representatives from the gateways, the primary business units of the enterprise, joined with corporate leadership to develop the effort. It was, as the larger organization, a mini-"united nations." But as with the larger organization, leadership and direction were set largely by Iridium managers, particularly John Windolph, director of public relations and marketing. A committee set decisions, with members equal, but the majority of gateway representatives were less attuned to transnational business than their US or European colleagues and deferred to their judgments. In principle, the advertising campaign could have aspired to the kinds of ideals argued for in the "Iridium Revolution" manuscript. Gateway members might have argued for a campaign that was attentive to issues of development—economic or social—in their respective regions. But these members were *investors* seeking to make Iridium a going global concern and to learn the ins and outs of transnational markets, to be students of Motorola's globally successful business practice, and, thus implicitly were rejecting or recalibrating pre-1980 modernization narratives of West to East, North to South.

The advertising campaign, as no surprise, then, focused on making a profit, not on ancillary ideals of global equity or enhancing the autonomy and sense of self of all individuals. But, yet, as the "freedom to communicate" slogan suggested, the language of universal Western ideals, as in other aspects of Iridium, found a ready home in the advertising effort, seamlessly conjoining those ideals with the

business objectives of sales and profit. As the venture had developed since 1990, it straddled the question as to what degree Iridium phones might be a product that reached a broad market or pitched itself at a more specialized niche. Such ambiguity was typical of media coverage (with the prior discussion of Iridium in *WIRED* as an example) and in some of the company's pronouncements, but not in formal proposals for bank funding or a stock offering. In the latter instances, it was clear that Iridium's business was built around sales to high-end users. Part of this ambiguity derived from Iridium's status as infrastructure that was, in terms of availability of a signal, literally everywhere and, in theory, potentially available to anyone. It was such defining structural and performance qualities that informed Textor and Moorthy's "Iridium Revolution" and their implicit argument that such an infrastructure would have profound social, Enlightenment-leaning values and implications—especially if Iridium established policies such as subsidizing the cost of handsets and service for users in developing areas.

But the broader possible implications of Iridium as infrastructure were in the background, subsidiary to the problem of organizing a customer base. As described in chapter 2, Iridium was conceptualized and designed in its *technical* specifications to serve a particular class of users—international "professional travelers," especially those from the United States, Europe, and Japan. "Professional traveler" was a term of art, embracing corporate personnel and celebrities —anyone with the means to be mobile transnationally. In particular, the new levels of international business activity in the 1980s created a substantial and, in the eyes of Motorola, likely increasing number of well-heeled people on the move across the international landscape, predominantly flowing from developed to undeveloped countries, and in need of improved communications options. Marketing studies estimated that the number of these travelers was not insignificant: 42 million. Even assuming only a fraction purchased the services, it would, according to Iridium's business plan, make the company profitable. To break even, the company needed about 500,000 of these potential customers to subscribe. The linkage between the years-long engineering effort and the advertising campaign thus was conceptual and material, at one with the basic assumptions of the system.

As described in chapter 2, to satisfy global travelers, Iridium was designed to meet a specific expectation of a professional traveler: to make a phone call from *inside* an automobile as a caller traversed from an international airport to its adjacent city, whether for business or personal purposes. The goal was to facilitate such travelers' ability to act and stay connected while on the move across the

international landscape, and to do so with relative convenience and ease. This core socio-technical agenda was given credence by a series of marketing studies, which then provided the basis for justifying the project's concept as Motorola and Iridium solicited funding from investors and banks through the 1990s. Within Iridium, at least as early as 1996, these assumptions were integrated into the work of a "war games marketing team." The target group of traveling elites was "75% male, many with kids, $95 K annual income, slightly older, college grad +, 8 in 10 married, professionals," with a major reason to purchase "business."[89] One such individual in a marketing study when presented with Iridium's service concept offered, "This is utopia. It's exactly what we've just been talking about—it solves all the problems."[90] Such analysis and perspective carried over to the 1997–1998 advertising campaign.

The importance of the metropolis-airport scenario in the venture's thinking reflected two aspects of globalization in the early 1990s. One was the centrality of the world's metropolises and airports in the articulation of transnational business patterns; the other was the state of cellular communications at the time, a service then concentrated in urban islands.[91] Iridium thus gave expression to a particular construction of how global business practice operated and of the infrastructure on which it relied—and, not least, assumed these modes would extend into the future. The crucial question of "for whom?" had been given at the beginning and had not changed in the intervening years. It now formed the basis of the advertising campaign, but was inflected by the potent conceptual Enlightenment imagery of Iridium as a planetary infrastructure that could serve not only professional travelers but also those with more modest lives in the world's developing regions.

As with nearly every other element of the Iridium venture, the advertising campaign was a window onto the making of the 1990s global, of its in-process nature. Because the ambit of the project was grandly transnational, with service slated to be "everywhere" from the first moment of commercial operation, with service sales points required to be at the ready for customers, the advertising campaign had to be global, to itself be everywhere, or at least where the professional traveler frequented, the metropolises and airports of the corporate diaspora. And, as was highlighted with respect to manufacturing in chapter 2, time was a critical variable. The campaign needed to align with the rollout of commercial service in the fall of 1998. Thus, the messaging needed to be developed and refined in several months, to arrive as an "emotional wave" in the summer of 1998 that reached "Europe, America, Japan, South America [and] Middle East Africa."[92]

This was a new challenge for the advertising industry. Corporate brands, even

for multinational companies, typically had been built up in a firm's country of origin, then expanded to new territory as the firm entered new markets. No corporate brand had ever been global from its inception. For its potential customers, hailing from a multiplicity of countries, Iridium had to create a consistent, compelling statement on what it was—as a service and as a social-cultural presence—in numerous locales in a swoop. Just considering the investor countries, say, China, Russia, Saudi Arabia, Thailand, and Canada, what concept and image, transnationally coherent, might mark Iridium as distinctively Iridium in all these places *and* induce a potential customer in these differing locales to purchase the service?

In the fall of 1997, John Windolph confronted this problem by organizing a gathering for major advertising companies to compete for the Iridium roll-out contract. Several companies, including the eventual winner, Ammirati Puris Lintas (APL), based in New York City, presented their approach to a global campaign to Windolph and Iridium's marketing committee.[93] Mirroring the changing global condition, and the needs of multinational corporations, APL was "a global team . . . composed of 7800 strong across 77 offices. And still growing." They, too, had come closest to thinking in terms of brands in a global context, recently concluding an effort to help Coca Cola raise its presence in South Asian markets. In pitching to Iridium, APL offered "a team that's forged through communicating, with each other, with our clients, in person, on the phone, via email or the Intranet—and we hope via wireless mobile phones through your satellites and systems."[94]

This moment in the 1990s was when, as noted previously in this chapter, the concept of the brand experience entered into the commercial view of the world, as the means to bind consumers to producers. In its October presentation, APL noted that "we must begin with a great idea—in the end it's ideas that move people . . . ideas that people buy." Earlier in 1997, Martin Puris, the company's CEO, in a think-piece on the state of the industry argued that a transformation was under way. He used that cynosure of marketing, the Disney Company, to describe a presumed shift among advertising, consumers, and culture. He noted that "Mickey [Mouse], on the other hand, is also a kind of advertisement, but he goes beyond that. Mickey is an experience—what I call 'a brand experience.' He reaches you in ways you do not realize . . . calls up a myriad of warm, emotional associations with Disney . . . his power to influence consumer attitudes derives principally from one single fact: he doesn't feel like an ad." Such erasure was what the industry and Iridium sought: "CEOs and their advertising advisors are at a

frontier we must cross together. . . . We must conceive ideas unconfined by media. . . . We must broaden our understanding of how and where consumers come into contact with brands . . . managing and enhancing those relationships."[95] Brand experience thinking and the rise of the post-1980s global went hand in hand. Aided by a $125 million budget, Iridium, its marketing committee diverse in membership, and APL aimed toward this very linkage during the next several months in creating an advertising campaign.

In meetings in Rome, New York City, and Bangkok, through several months from late 1997 to early 1998, this collective developed the campaign, focused on business travelers and their world perspective: to be free to communicate across borders and circumstances, to be forward-looking entrepreneurs, to be unconstrained in their possibilities for work and inner attainment, to be girded with a technology that would mitigate risk and anxiety, to be frictionless. Ideas were pitched and a campaign took shape. APL's Robert Quish and Roger Bentley were critical to the process, taking Iridium as an exciting puzzle. Quish, as account manager, saw the project enhancing APL's ability to meet the conditions of a global world. Bentley, the creative director, had run APL's effort to extend Coca Cola's market in Asia, confronting the challenge of implanting a Western brand into a non-Western cultural setting. The problem of "universalizing" a brand—whatever that substrate of shared or compatible meanings might be—interested him. Iridium, as a communications product, one that came invested (unlike Coke) with core Enlightenment values, seemed an irresistible call. The perceived novelty of doing a global brand de novo, conjoined with Iridium's multiple of-the-moment threads, led John Windolph to invite *The Wall Street Journal* to cover the development of the campaign in situ, to watch and report on the jumble of contending forces and issues. The result was a series of articles that showed the fault lines of the global.

Earlier in 1997, prior to involvement with APL, Iridium had begun to realize the need to create a corporate image that evoked more universal associations, some commonality across cultures. It undertook to revise, under Windolph's direction, its then existing logo, a static configuration of satellite orbits encaging the Earth. Indeed, its own staff referred to this image as the "cage" (fig. 4.3). Iridium hired a renowned firm, Landor Associates of San Francisco, to revamp the logo, to erase the technology from the image and create a design that might be positively evocative for a range of cultures. After a series of focus groups in Japan, Brazil, and other countries, Landor arrived at a stylization of the Big Dipper, a logo design meant to convey a message that would have a positive connotation

Figure 4.3. Original Iridium logo, emphasizing the way in which the satellite constellation enclosed the planet through an ordered technological system. Courtesy of Iridium Satellite LLC

across multiple cultures: durability, mythic-ness, and an implied relation between Heaven and Earth (fig. 4.4). By the time of the APL effort, several months later, the Iridium marketing committee already was primed to think in terms of creating meaning within a global frame.

Based on their prior work, and through meetings with Windolph, Quish and Bentley began the project with strong ideas on the direction of the advertising campaign, ones that built on the international traveler as a fundamental target. The meetings with Windolph and the marketing committee sought to hone the focus and, importantly, to draw out in what ways the "freedom to communicate" message might need to be presented in the different regional cultural contexts represented by the Iridium committee members, to understand resistances, large and small, down to phrasing, color palette, and typefaces, and the subtle meanings that each of these facets might convey in different locales. The result was the advertising campaign, a synthesis of language, design, and images intended to

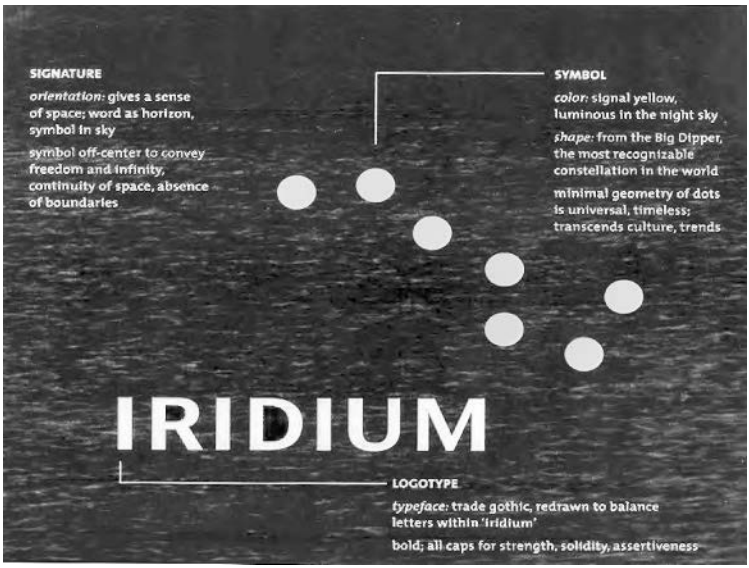

SIGNATURE
orientation: gives a sense of space; word as horizon, symbol in sky
symbol off-center to convey freedom and infinity, continuity of space, absence of boundaries
SYMBOL
color: signal yellow, luminous in the night sky
shape: from the Big Dipper, the most recognizable constellation in the world
minimal geometry of dots is universal, timeless; transcends culture, trends
IRIDIUM
LOGOTYPE
typeface: trade gothic, redrawn to balance letters within 'iridium'
bold; all caps for strength, solidity, assertiveness

Figure 4.4. Landor Associates' 1997 redesign of the Iridium logo to make cultural associations, presumably shared transnationally, as the core message and purpose of Iridium. The Big Dipper logo is a registered trademark of Iridium Satellite LLC. Courtesy of Iridium Satellite LLC

convey a core, global message, to codify the meanings of the venture—to Iridium and publics around the world.

One of the first steps, though, was to refine the framing of the basic messages. In December 1997, after a meeting of the marketing committee in Rome and in preparation for another meeting in New York City in January, APL provided a draft outline of the messaging. It drew together the technological (primarily comparing Iridium to the then limited coverage of terrestrial cell phone networks and the welter of different network protocols) with the perceived psychosocial characteristics of global business travelers. The former Iridium could address, the latter fell to the art of aligning a product with a "market segment." The "core issue," as expressed in the outline, was that "a customer needs to be able to communicate with anyone on the planet at anytime from anywhere—simply and with no hassle." This contrasted with terrestrial-based cellular, which used the rhetoric of universal service (thought not the ideology of universalism), but in actuality left vast swaths of geography uncovered, which users directly experienced when their phones registered the "dreaded words 'no service.'" A primary objec-

tive of the campaign should be "to cut through the misleading, overpromising white noise of telecommunications advertising to create awareness and a unique identity for Iridium" and its distinct capabilities.[96]

Foremost, though, the campaign sought to speak to the professional traveler's sense of self and status. The words and imagery would connect with "an international clan of global warriors who regard themselves as the elite of the world, whether that world is business, journalism or industry. They spread their lives across national boundaries, time zones and, importantly, cellular protocols. . . . They are changing the world. They have boundless vision, a positive mindset and expect a can-do attitude from everyone around them." This was a world defined by the market though, not merely attitude. In this context, Iridium users were "competitive and want assurances of knowing that you are armed with the best communications tool in the world, so that no one has a better chance of success than you." Yet such success, striving, and élan on a global scale had their costs: "this lifestyle forces them to live by remote control which engenders a feeling of isolation and paranoia because they are too often denied contact with their families and with those to whom they must delegate professional responsibility." Through the next several months this tension between the aspirations of a historic, change- and taste-making class, devoted to the possibilities of the market, and the burdens they endured became the organizing message of the campaign. And, of course, it was Iridium technology and service that would erase this tension and make easier the professional and personal life of the global traveler.[97]

For Quish and Bentley, the underlying conceptual problem of the campaign was how to position a cosmopolitan entrepreneur—whether, in their words, an executive from a Fortune 500 company or a setter of global taste, such as "Donna Karan and the Gianni Versace"—defined by her or his motion in the evolving construction of the global in the late 1990s and beyond.[98] That positioning had to be clear and bold and had several elements: to identify the planet as a borderless field of action, to find accommodation with a world full of cultural particularity, and to highlight the importance of the metropolis in transnational business.

Images were the primary means for conveying these messages. For the first, the desert became a crucial trope (fig. 4.5), as did perspectives from space (fig. 4.6). Each connoted the erasure of national borders and, importantly, national constraints on entrepreneurial action. Through this de-bordered landscape moved the entrepreneurs, or in the lingo of the creators of the campaign, the "global warriors." Bentley's idea, in extremis, was to create a campaign that made the "world . . . your playground . . . [that] this is where you can do your business and

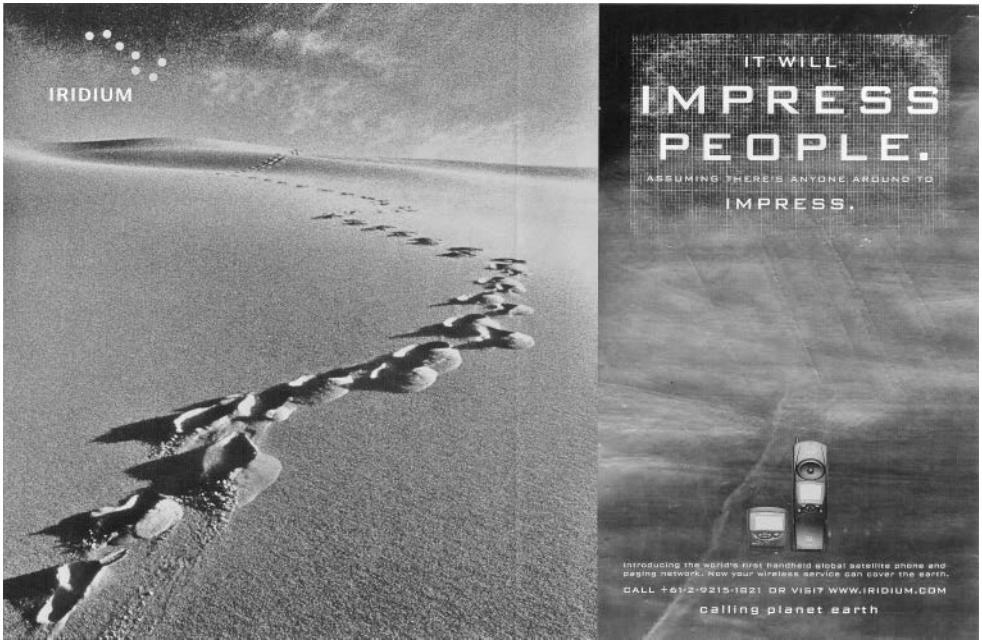


Figure 4.5. The desert as trope was used to convey an Iridium user's ease of movement across the global stage. Similar desert imagery graced the cover of Iridium's 1998 annual report, with a time/date stamp indicating the moment of the system's commercial inauguration. Courtesy of Iridium Satellite LLC

do your thing . . . [with] the idea of if you're going to own the world you'll need a phone that can follow you around."

Such images dovetailed with others meant to dissolve or shift the meaning of culture as locally situated. To operate, the global warrior needed a new vantage with respect to the local. Again, the campaign's architects distilled this perspective into the raw below-the-surface assumptions taken to order the worldview of elites:

> We had to take out certain elements of culture and . . . leave them behind. . . . The warriors whether they were from Africa or from Asia or from North America or South America, what they represented was a new sort of republican, a person who belongs to a different country than [his or her] country of origin. . . . In a sense, they would belong to the Republic of Iridium, and they would be global warriors who are definitely in the business of making money, so it was capitalism and its clients. . . . We didn't want there to be a person who was multicultural. We wanted him to be in a world that was full of culture.

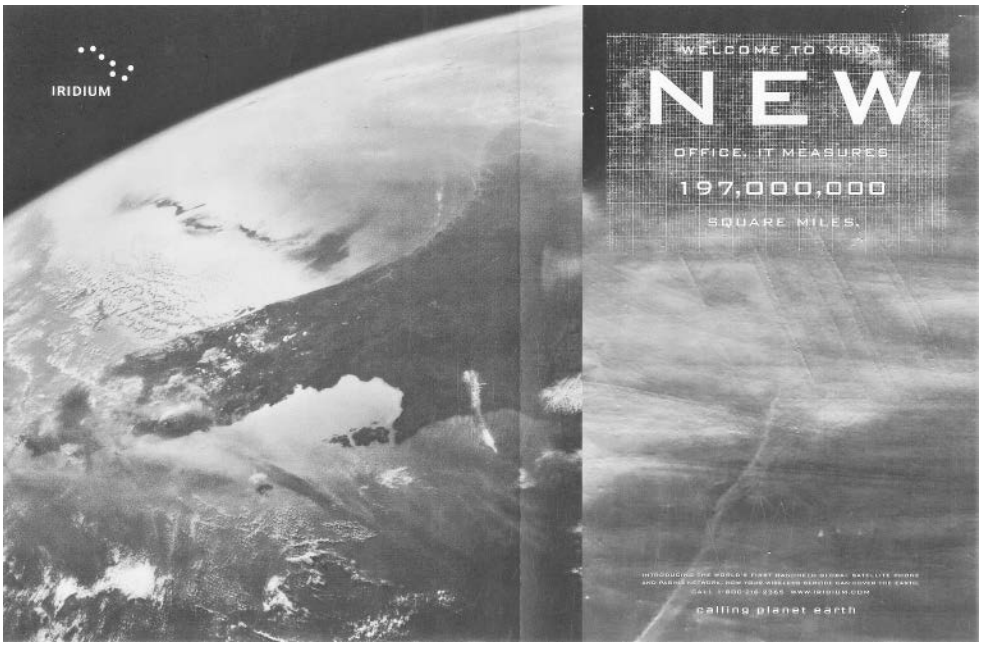


Figure 4.6. Advertising designers saw this image and message as appealing to elite travelers, presumably desiring the ability to communicate anyplace on the planet. A similar ad was created in conjunction with National Geographic, showing an image of Earth from space with the tagline "A detailed map of your calling area can be obtained by calling National Geographic." Courtesy of Iridium Satellite LLC

In the "Republic of Iridium," culture was plastic, a symbol detached from any particular real culture, that gave the appearance rather than the substance of awareness and knowledge of the local. As expressed in one document, the campaign needed "a communications idea that will define Iridium in every country on earth. Consequently, we must rise above ideas that are anchored in national cultures. This idea must also be capable of interpretation across a wide range of media—press, posters, in-flight magazines, leaflets and brochures, interactive, direct mail" (figs. 4.7 and 4.8).[99] Such thinking had a particular demographic inflection. As one marketing study noted, "marketing Iridium to the world is made simpler by the fact that the primary market, heavy travelers, is made relatively homogeneous (less culture-bound) by virtue of common needs and interests imposed by travel."[100] This was the polar opposite of Motorola's thinking in *Uncompromising Integrity*, in which the goal was to at least acknowledge the legacy of the colonial and problems of equity. These contrary postures reflected a key

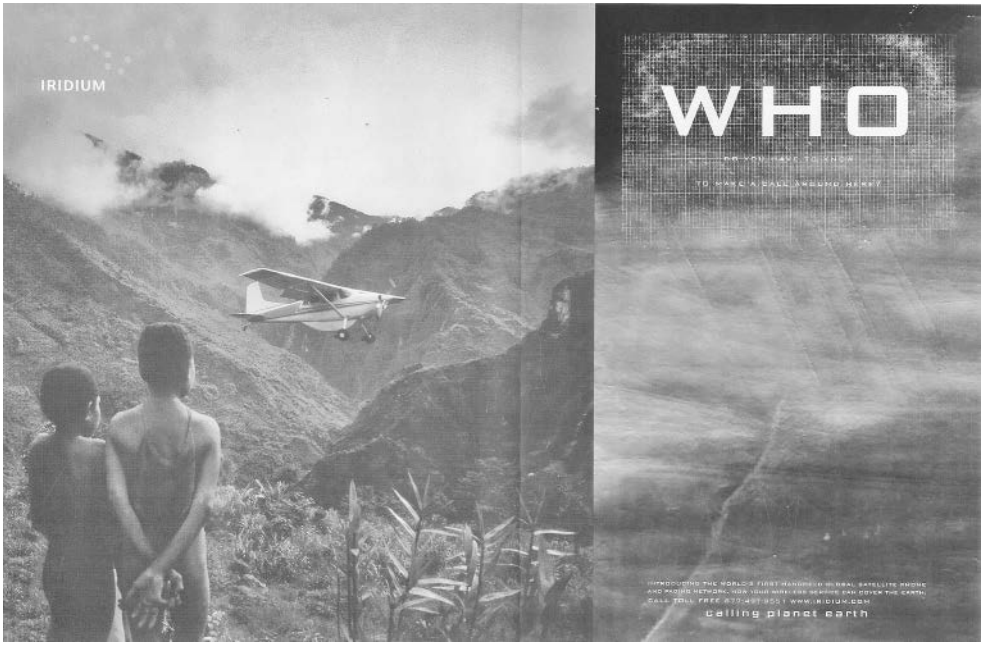


Figure 4.7. Reflecting the assumed cultural preoccupations of elite travelers, this ad captured the disjuncture between the developed and developing worlds, their political and economic imbalances. Here the airplane symbolizes, as did the Iridium phone, the problematic of the relation between modernization and capitalism and non-Western cultures. Courtesy of Iridium Satellite LLC

difference of the two offerings. *Uncompromising Integrity* reflected the problem of ethics when a factory or sales office was implanted in a non-US setting and had to confront the meaning of being in a community day after day, of continual contact and interaction with individuals and their culture. Iridium, in contrast, was about mobility and the act of passing through, of tangential, episodic relation to the local.

But one could not escape legacies of history so readily. The advertising stratagem looped back carefully, on how to balance the generic theme of the global warrior and the specific reality that many of these warriors would be from developed countries: "We needed to have that lofty approach . . . although we could come in sometimes and say, 'I'm going to take over the world,' that had to come from somebody from Thailand or somebody from India. It couldn't come from an American or a Brit. If an American came out with, 'Your global empire now comes with this handy remote control,' it would be so audacious, and you would

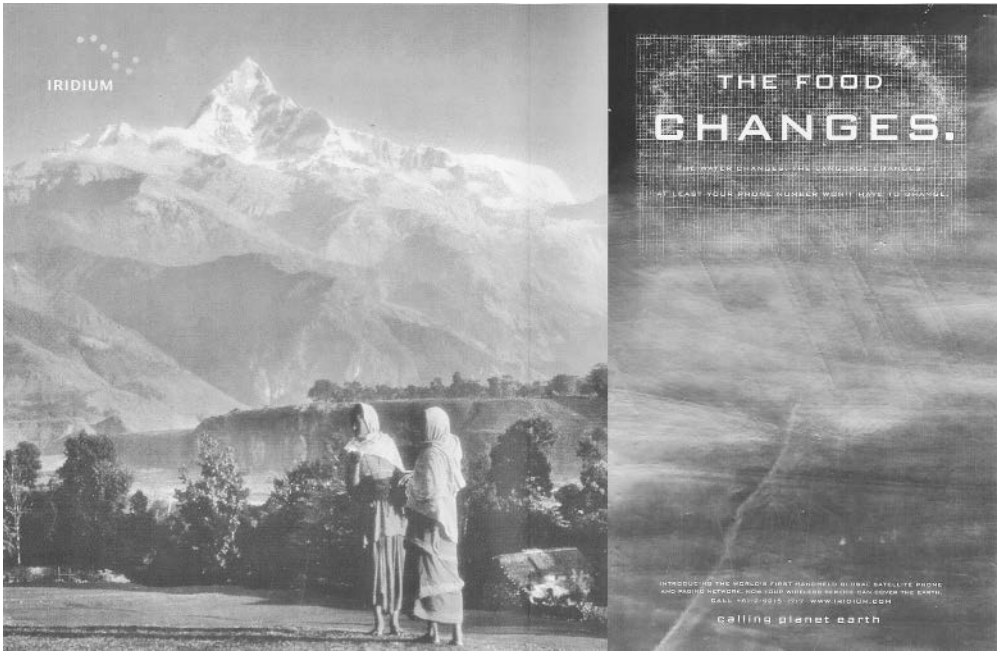


Figure 4.8. The critical message in Iridium's advertising was to address the unease of elite travelers with what they might encounter in unfamiliar or exotic cultural settings. In this case, food symbolized such dislocation, with Iridium promising a means to sustain elite expectations no matter the locale and its differences from an elite lifestyle. Courtesy of Iridium Satellite LLC

lose every, you know, Muslim person in the world." This underlying current of the imperial in contemporary capitalism made the metropolis and the airport signs of the past *and* of a market-enhanced future, at least as envisioned by the "Iridium Revolution" and by Iridium's non-Western investors. Such tension made these sites signature tropes of postmodernism and the global condition, and they were, as noted above, central to Iridium. They were the first site of action for the global warrior and the interstitial space between the airport and its metropolis needed to be brought under control (fig. 4.9). When the campaign ran, airports and their immediate environs were primary sites for advertising placement, as were publications such as *The Wall Street Journal*, *Business Week*, and the *Financial Times*. Television commercials on CNN and business cable stations amplified the effort.

Though remoteness and its unruly possibilities were dominant motifs of the campaign, they had a dual valence. This "no place" ad (fig. 4.10) offered a stark rendering of disconnectedness, especially in terms of Western business travelers

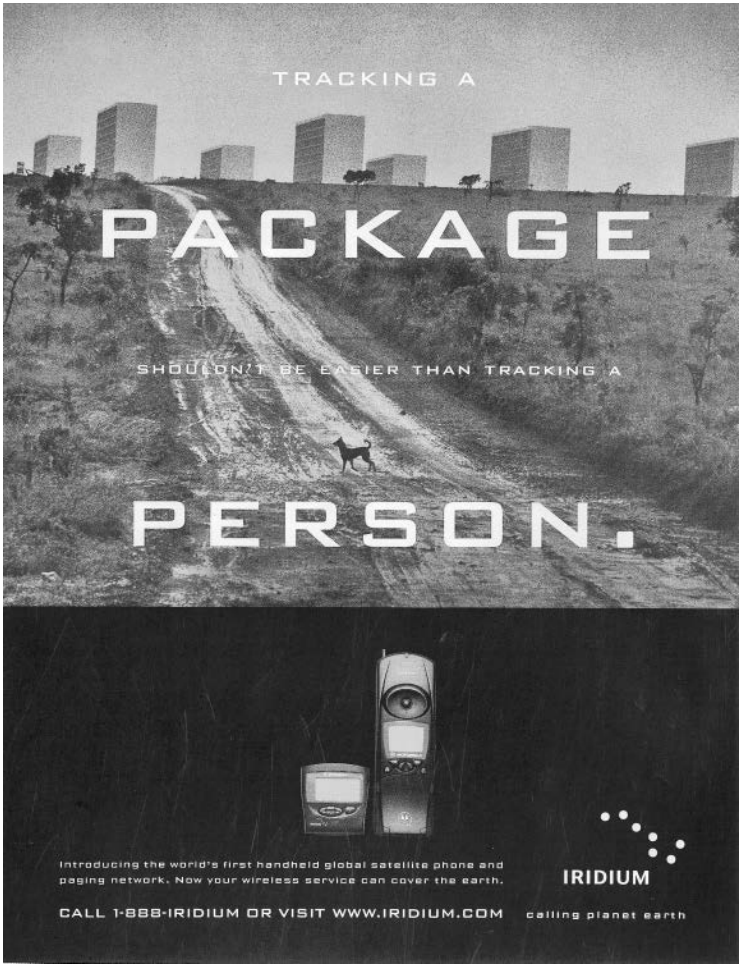

TRACKING A
PACKAGE
SHOULDN'T BE EASIER THAN TRACKING A
PERSON.
Introducing the world's first handheld global satellite phone and paging network. Now your wireless service can cover the earth.
IRIDIUM
CALL 1-888-IRIDIUM OR VISIT WWW.IRIDIUM.COM
calling planet earth

Figure 4.9. This advertisement indirectly invoked the actual and metaphoric distance typical between an international airport and its associated metropolis—that interstitial space Iridium service offered a means to control. This image of Brasilia featuring a dirt road and a wild dog gave special emphasis to the uncertainty and loss of control that might confound the global warrior. Taken in 1961, this stock image muddied the temporal relationship between developing countries' past and present and, in turn, that relationship's place in the imaginary of an Iridium user. Also, note the minimal presence of the technology in the image itself, reflecting that the advertisement's primary aim was to appeal to a perceived emotional need, not the gadget itself. Courtesy of Iridium Satellite LLC

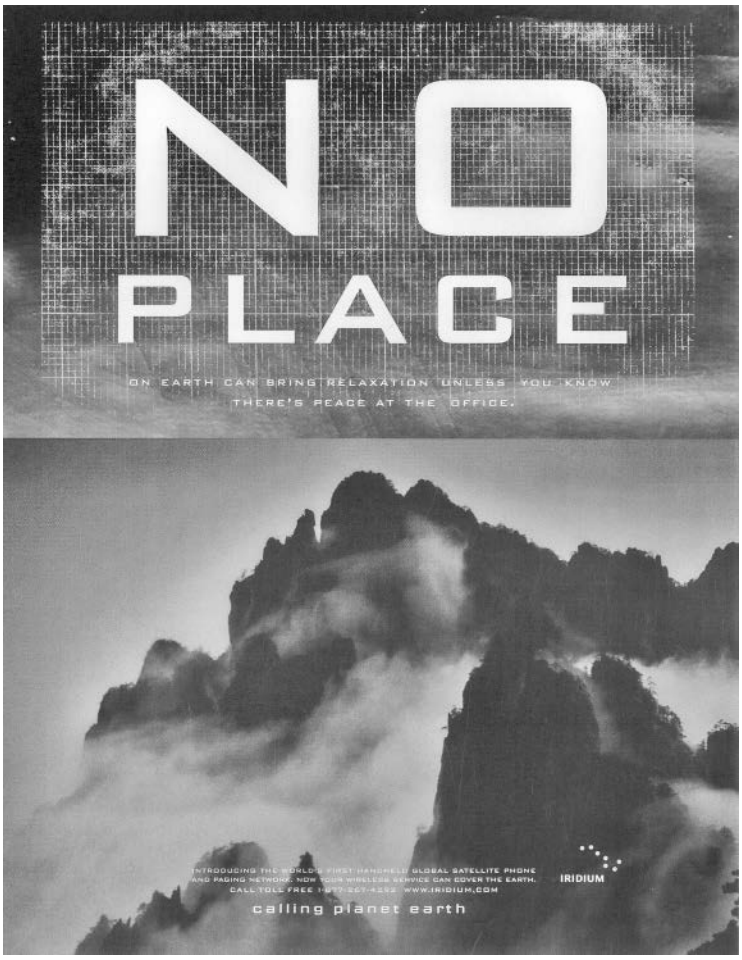


Figure 4.10. Anxiousness at being out of touch with the office was seen as a critical message to sway global travelers to adopt the Iridium service as a solution to their business and lifestyle needs. Courtesy of Iridium Satellite LLC

anxious about the absence of a reliable connection to their office. More broadly, it captured the ambivalence about "place" in the imagery of globalization, in which "place" for the global elite might refer to the locally specific or, as in these ads, its erasure or its becoming an abstraction. But remoteness also took on a positive valence—an Iridium phone enabled elite travelers to see unpeopled places or rugged environments as a prerogative of the globally mobile, as new opportunities for adventurous self-realization. This angle was central to the Iridium Ad-

venture Series sponsorships described previously in this chapter. It also found expression in the advertising campaign (fig. 4.11) as a way to suggest that mobility not only facilitated one's business aspirations but also maximized one's life experience as a global elite, characterized in this context as "an explorer, a visionary, a risk-taker."[101]

As noted in chapters 2 and 3, Iridium in its engineering and business concepts

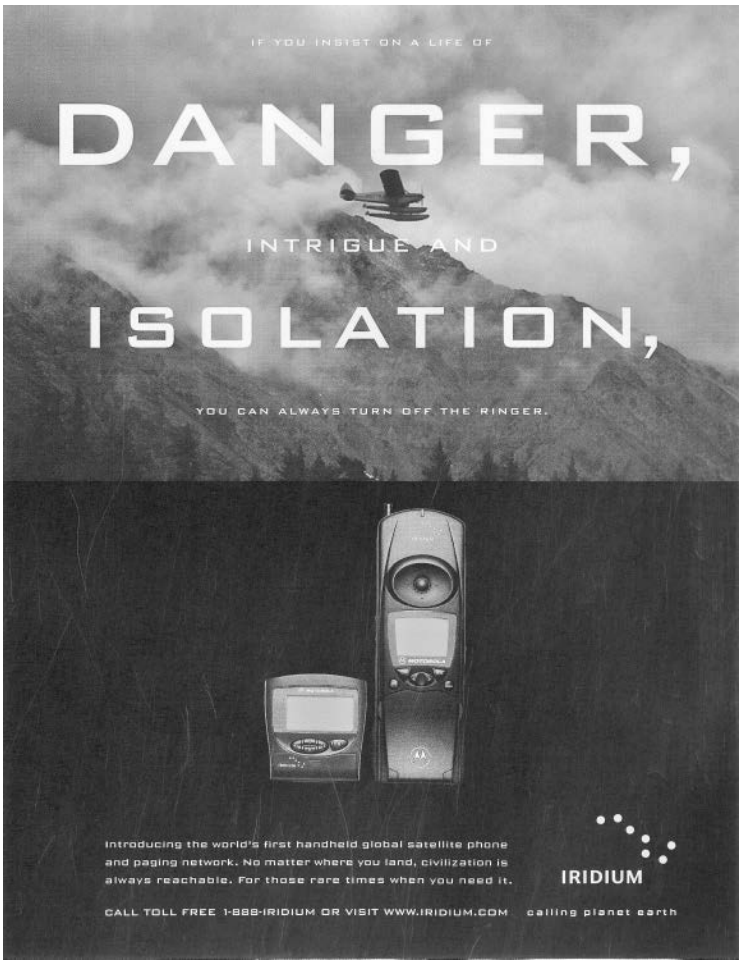

IF YOU INSIST ON A LIFE OF
DANGER,
INTRIGUE AND
ISOLATION,
YOU CAN ALWAYS TURN OFF THE RINGER.
Introducing the world's first handheld global satellite phone and paging network. No matter where you land, civilization is always reachable. For those rare times when you need it.
IRIDIUM
CALL TOLL FREE 1-888-IRIDIUM OR VISIT WWW.IRIDIUM.COM
calling planet earth

Figure 4.11. This ad shifted the connotations of "danger" and "isolation" away from the "unease" presented in other ads to a positive attribute. One's status was not just about having the phone but also choosing to turn it off in search of adventure or self-fulfillment. Courtesy of Iridium Satellite LLC

embodied the deep interconnections between the market and the military in the 1990s global. This carried over into the advertising campaign. Though a relatively small part of the effort, Iridium saw military users as a key market. Their approach was much the same as to the commercial market—to highlight the unease in not being able to communicate when operating on a global scale. Figure 4.12 is emblematic of a series of military-focused ads that linked the global coverage of

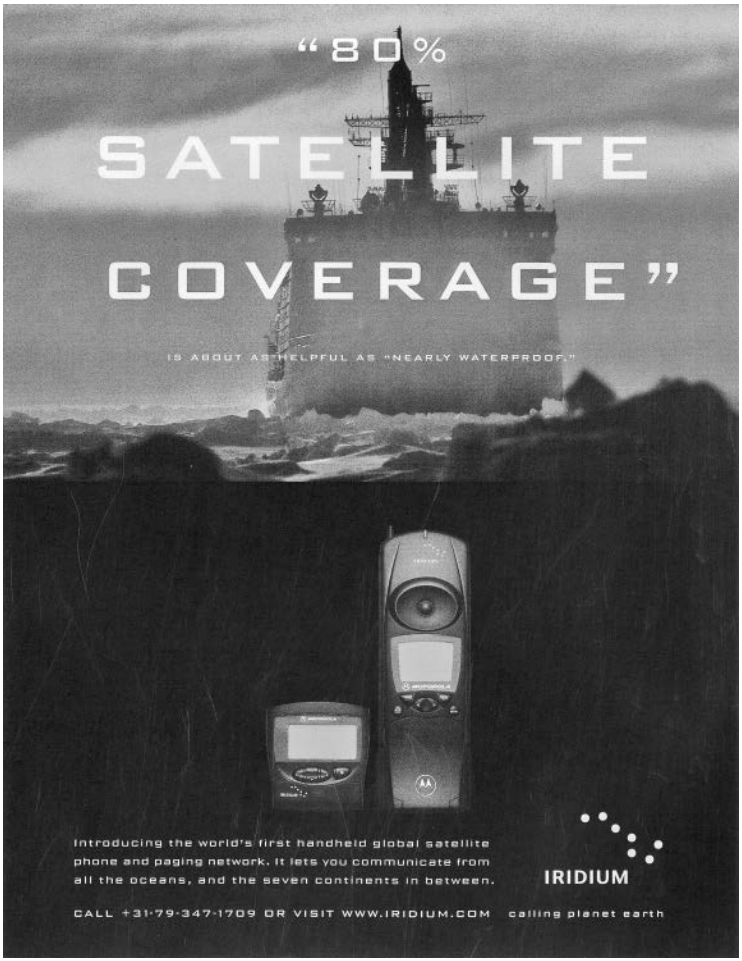

"80%
SATELLITE
COVERAGE"
IS ABOUT AS HELPFUL AS "NEARLY WATERPROOF."
Introducing the world's first handheld global satellite phone and paging network. It lets you communicate from all the oceans, and the seven continents in between.
IRIDIUM
CALL +31-79-347-1709 OR VISIT WWW.IRIDIUM.COM calling planet earth

Figure 4.12. This ad reflected both the problem of reliable, easy communications on the oceans as well as the US Navy's near-global activities, a key reason for designing Iridium with fully global coverage. Courtesy of Iridium Satellite LLC

Iridium with the global scale of US military activity—as previously noted, one of the very reasons for creating Iridium as a service fully global in extent.

In good advertising fashion, all of the images in the campaign sought to combine empowerment for the global warrior (whether a figurative commercial user or an actual military user) with a dose of unease. For the commercial global elite, nature or the real consequences of moving through real cultures and distant places might thwart the warrior mission. The world was yours but only if you had an Iridium phone in your briefcase. In the summer of 1998, as a follow-up to the Iridium television campaign, APL conducted focus groups with viewers and found that the commercials created "the impression of new technology that will both *simplify the lives* of and *empower* international business travelers." And according to the interviews, they did so in the way that APL and Iridium had hoped, to "keep the user connected ('I don't have to be out of range anymore') . . . provide the freedom to make calls whenever and wherever needed ('telecommunications is no longer restricted to calling areas') . . . provide the peace of mind that the user will be able to do their job more effectively ('it reminds you of the risk if you do not stay in touch') . . . [and] eliminate the hassle of overseas communications ('less frustration; it will make traveling easier')." Though such thoughts did not quite carry the assertive tone of the global warrior, they did connect to their target audience. Interviewees felt that the ads were talking to people "like them" and had "a real 90s sense of humor, fun but serious." But cultural disquiet emerged: that in the "depiction of third world countries . . . some respondents were put off by the 'third world country' feeling of some of the images . . . found it hard to be thinking of high-priced satellite phones when they were wondering where the people in the ads were getting their next meal."[102]

The rhetoric and images of advertising almost always invoke the tragicomic—the difference between fantasy and an ever-insistent reality painfully obvious. But as much as engineering, politics, and business aspects of the venture, the advertising campaign captured the tacking, the shifting of registers of meaning and power, of the intersecting roles played in the new market world—especially when juxtaposed with the ideological dispositions of the "Iridium Revolution" and *Uncompromising Integrity*, near contemporary endeavors. The campaign threw into relief the vast disparities of power inherent in globalization—a recrudescence of older and not so old instantiations of imperialism, hegemony, or empire.

But the bluntness of the campaign's imagery and words stood alongside a critical fact: the involvement of Iridium's "united nations" stakeholders as coproducers. Indeed, for example, the rhetoric of the "global warrior" found ex-

pression in India. APL, in conjunction with Iridium India, created an Iridium-sponsored television show called *Global Warriors* to "profile the lifestyles of Iridium's target customers" who lived in India.[103] For those traveling to India, the advertising taglines were "Iridium Works Here" and "Good Morning, Sir."[104] This circumstance, this hybridism, lumpy and uneven in its constituents, suggests that we take seriously the idea that the 1980s and 1990s yielded a distinct cultural formation in which the global became a problem for a variety of actors, a problem that induced new configurations of practice and meaning (or, at least, unsettled older configurations), a problem intensified by the ability to act technologically and under the auspices of the market over the totality of the planet. And that to understand these configurations we need to see the corporation not just as a wielder of power, an instrumentality for advancing its own ends, but as a participant in a larger cultural undertaking, one in which it was both a producer and a consumer.

Chapter Five

From "it's a bird, it's a phone" to "Edsels in the sky"

Or, the End of Iridium's Global Vision

> "By the time Iridium is up and running in 1998 the world will be covered by so many terrestrial cellular networks that there will be no reason to have an Iridium system or any other satellite-based system," said industry researcher and consultant Herschel Shosteck. The concept of instant communications anywhere, any place is nothing more than pandering to wealthy corporations.
>
> *CHICAGO TRIBUNE*, JANUARY 31, 1995

> To Al Gore, this was a milestone in the nation's continuum of innovation. In a Rose Garden ceremony last October, the administration's techie-in-chief placed the first call on a mobile phone system called Iridium, a celebrated project that let users communicate from anywhere on the globe . . . but ten months later . . . the District-based company finds itself galaxies removed from its giddy launch day, Iridium has spiraled earthward with startling speed, a dazzling triumph of innovation flipped into a huge piece of corporate junk.
>
> *THE WASHINGTON POST*, AUGUST 21, 1999[1]

For more than a decade, Iridium had been a malleable symbol, a ready container for narratives of the neoliberal and global, of new communications technologies as romanticist-engines for empowering individuals to shape themselves and the world. As Iridium Chairman Robert Kinzie said in 1992, "This is not just a phone; it is a vision." Counter to such period enthusiasms, Iridium, too, engendered critique—as a concept, as a business plan, in its claims to be a beneficial agent of change. Yet as the satellite constellation and business began commercial operations on November 1, 1998, Motorola and Iridium seemed on the verge of vindication. The *WIRED* article on Iridium in October 1998, covered in the previous chapter, exemplified the view that this exercise in business bra-

vura had come through. Turns of phrase such as the "united nations of Iridium" and "it's a bird, it's a plane, it's the world's first pan-national corporation" presented the venture as a signature statement of the 1990s: technology, corporations, and markets were remaking the global landscape and the imaginations of billions of consumer-citizens to dizzying, salutary effect.

A mere five months later, though, Iridium's business fortunes had faltered dramatically; customers were signing up for the service in far fewer numbers than anticipated and, more importantly, than would enable Iridium to meet the requirements of its bank loans. In May 1999, as the company confronted the possibility of bankruptcy protection, *WIRED* published another piece entitled "Iridium: Edsels in the Sky?"—a cutting reference to an earlier emblem of colossal techno-business failure, Ford's Edsel automobile.[2] In a few short months the narrative of corporate daring on the market frontier flipped to narratives of managerial short-sightedness and ineptness, even irrationality. This efflorescing critique of Iridium did not signal a questioning of the idea of the global, only that the company had committed two mistakes. One was mundane in the context of business history: it misread, in epic fashion, the shifting contours of the market, in this case, the 1990s spread of terrestrial cellular service and the assumption of pent-up demand for a global telephony service—and paid the price. Though the two critiques were related, the second was more specific to the enterprise: in promoting a global business avant-garde Motorola and Iridium failed to build fully the on-the-ground conditions that would enable their vision of global communications to succeed. Despite all this, the global as a powerful trope for period actors and as a category of practices remained intact. Iridium, in its 1990s form, only was a casualty of its elaboration—as would soon be the other satellite telephony ventures and Teledesic, the Internet in the sky. In 2001, as *Forbes* looked back on the business doings of the past decade, the question was posed, "What is the biggest failure in tech history?" The immediate, curt answer was "Iridium."[3]

This chapter covers Iridium's business demise and its relation to shifting notions of the global, as the 1990s heyday moved into a new millennium sobered by the dotcom bust and 9/11 terrorist attacks, with the latter reemphasizing the intertwined relation between US national security and US preeminence in markets. The previous chapters foregrounded the ways in which the global was a future-oriented narrative, stitching together aspirations and actions of a variety of actors, internal and external to Iridium. Differences in outlook, or the reality of the many friction points in constructing the global, receded to the background or were seen as solvable through a can-do alignment with the period's forces. But as

Iridium faltered nearly as soon as it began commercial service, such differences and realities moved to the foreground. They, in turn, became entwined with idiosyncratic elements that might have been present with any business venture. In this case, the relations between a parent company and its start-up, between Motorola and Iridium, in which Motorola's interest was not only to facilitate Iridium's success, but also to profit from being the sole provider of satellites, ground equipment, and services to its start-up. Not insignificant, too, were the personalities of key people, such as Iridium CEO Edward Staiano.[4] These, in combination, raised the question of whether a US corporation, with its specific interests and hierarchical style of management, its contrasts with developing countries, could bring these many moving political and institutional parts of the project into an effective whole, ready to be global in one fell swoop.

But, broadly, the venture's collapse was rooted in the very fusion that gave it life: the adaptation of a Cold War world to one shaped by corporations and markets, a tandem that the United States, in particular, through the idea of the "Washington Consensus," saw as vital in remaking geopolitical space. Though the collapse of the enterprise had multiple, interconnected causes, the venture's "united nations" politics played a major role. In the wake of the Cold War this trope of collective, cooperative action had enormous feel-good and practical appeal. But it embodied challenges specific to Iridium and the 1990s. In its technical operation, the system did not require any nation-state—it embodied the market ideal of a borderless world, completely open to flows of capital, information, and market citizens. But the political legacy of the Cold War and of the twentieth century required accommodating and using "nations" in developing the project. This took a variety of forms (covered in chapter 3). One that proved debilitating was a political-business model that made the "united nations" not only investors but also operators of the Iridium business in their respective geographic areas. The many partners from less-developed countries or with state-centered economic systems were not, by prior experience, readily prepared to assume this key market-driven responsibility. In 1996, as part of Iridium's need to convince banks and the bond market to provide funding, the consulting firm Coopers & Lybrand prepared an extensive "marketing due diligence phase I report." It identified China, Russia, Colombia, Argentina, and Hungary as "high-risk" countries in relation to their ability or readiness to meet the venture's business goals. In the case of China, the question of the "assignment of bandwidth," a fundamental element of a communications undertaking, "is unknown." For several countries "confusing, unpredictable, and under-developed regulatory processes" might thwart

the business. Other countries were designated as "moderate risk," including the United Kingdom, Italy, Mexico, and India for similar, but less egregious shortfalls in policy or organizational capacity.[5] Such issues became the central preoccupation of Iridium leadership in the period leading up to commercial launch and in the early months of 1999 as they sought to save the company. In March 1999, as the banks closed in, Iridium only had achieved 87 percent of its expected service coverage and "6 markets in top 27 remain unlicensed: Iran, Mexico, South Africa, Algeria, Pakistan and Morocco."[6]

The Coopers & Lybrand report led to an extensive revision of the Iridium business plan, which won the favor of the financial community.[7] Yet the plan-on-paper never resolved the on-the-ground issues embedded in Iridium's developed world–developing world structure. Iridium had the ambitious task (in hindsight, a staggering organizational hurdle) of being a vehicle for building up the political and economic infrastructure for the global (or, its slice of it). But all of this misses the broader assumption: a belief that a key vector in building the 1990s global would occur through US-style corporate capitalism, that this organizing modality was the means by which participants such as Russia, China, and smaller Second and Third World nations would help co-constitute or, at least, accept a transnational market order. Such belief was manifest from the beginning. In Motorola's filing to the FCC in late 1990, the company offered the shared corporate-governmental assumption that for "new market economies, including most Eastern European nations and the Soviet Union . . . the telecommunications capabilities of the Iridium system will assist these nations as they democratize their political structures and liberalize their economies."[8]

The media critiques of Iridium and Motorola that bloomed as their business troubles became apparent largely missed this deeper structural aspect of the story. These critiques took the "market" as an abstraction, a thing already in existence, in which either actors "read" or "misread" its opportunities, a binary that brought either success or failure. For Iridium, the market was a field of action that required the company to build the means for its product to enter the world of consumption, especially in developing regions. Not surprisingly, perhaps, the articulation of the necessary political and economic infrastructure proved more elusive than the challenge of creating a planet-embracing technical system—even within the framework of a profit-seeking, multi-investor corporate enterprise, aided by international and national authorities. The story of the global in the 1990s is inseparable from this tension between market ideals and local state and business capacities—and different interests, cultural styles, and relations to

colonial legacies. This, of course, was entangled with the overlapping problematic of the market turn: the allocation and configuration of power between private and public actors.

The Iridium collapse threw into relief, too, another deep characteristic of the 1990s global: the close linkage between the development of invigorated conceptions of the market and military interests in acting over the totality of the planet. As noted before, Iridium had close ties to the US national security agencies throughout its development. For Iridium, these served as obvious customers and political allies. For the national security establishment, Iridium provided a "big technology" solution to a perceived need: global "anywhere, anytime" communications—with the added benefit that the development expense would be borne by private capital rather than congressional appropriation. As Iridium's bankruptcy unfolded in 1999 and 2000, Motorola threatened to de-orbit the entire constellation of satellites. The Department of Defense (DoD) stepped in, pushing several private investors to rescue the venture. It promised to execute a contract with the new entity, thereby providing a post-bankruptcy Iridium with a steady flow of cash. The Iridium-DoD connection intensified, post–September 11, with the wars in Afghanistan and Iraq, as the phone service became a crucial in-theater asset.[9]

The market-military connection in making the 1990s global was not idiosyncratic to Iridium. The US Global Positioning System (GPS), starting full operation in 1995, occupied the same nexus of the global, markets, and military interests. But in that case the flow of interaction occurred in reverse, from military to market use. Iridium, GPS, and other cases demonstrate the persistent juxtaposition of military and market developments in the articulation of the 1980s and 1990s global. In the 1990s, market-generated tropes gave the period its distinctive cultural and imaginative impulses: romantic, transcendent, and future leaning. Military conceptions of the global drew on a different imagery: control, surveillance, and projecting power at a distance. The near-contemporaneous bust of the dotcoms and 9/11 inverted the standing of these tropes in Western culture, or at least gave them equal prominence. The global, as a category and a condition, in the early years of the new millennium tended to highlight the latter rather than the former associations.

A global infrastructure, too, potentially served more than the neat categories of business elites or the US military. Within weeks of the system's inauguration, intelligence officials surveiling Colombia drug traffickers moving cocaine in fish-

ing vessels speculated that "while there has been no confirmed trafficker use of the new Iridium satellite cell phone system, estimate traffickers will begin to procure this equipment soon and expand its use as the system reaches maturity."[10] It also merged, too, ambiguously with US relations with undemocratic regimes. In September 1999, with Iridium in bankruptcy, Egypt submitted a request to US intelligence officials for the "purchase of a radio reconnaissance station for satellite communications," with its primary purpose "to search, detect, monitor, analyze, and report all types of Inmarsat [International Maritime Satellite Organization], Iridium, Globalstar and satellite communications signals."[11] Both of these snippets stand as markers of the way in which Iridium's avowed idealism was getting submerged into the chaotic realities of global life.

The Beginning of the End

More than 10 years after Motorola engineers Bary Bertiger, Ray Leopold, and Kenneth Peterson conceived a space-based personal cellular system, and 5 years after the availability of investor funding, Iridium inaugurated commercial service on November 1, 1998. The test of the Iridium concept was now at hand—as a technical system and as a business enterprise. As marketing studies through the 1990s had analyzed, a consumer base of tens of millions was possible—all Iridium needed to recoup its investment costs was to attract 500,000 to 600,000 customers.[12] A January 1998 Gallup study executed in New York City, Frankfurt, Rome, Dubai, São Paulo, Hong Kong, and Singapore seemed to confirm such expectations. Gallup's summary of its focus group interviews was "Global is the key word" in attracting potential subscribers to the service, but noted that interviewees "expected satellite reception to be better than cellular. This expectation, if unfilled, could lead to dissatisfaction."[13] To reach these individuals, and the hoped-for number of subscribers, Iridium had set aside $125 million for a marketing campaign in the summer of 1998 that included public relations; a worldwide, direct mail effort (translated into 13 languages); and advertisements on television and on airlines, airport booths, and Internet web pages. Marketing Iridium as a service in a variety of cultural contexts, as chapter 4 covered, posed its own challenges.[14]

But the phone itself, as a consumer object, played into the questions surrounding the commercial rollout. Through the 1990s, cellular phone design had produced smaller, sleeker phones. The initial Iridium phone, comparatively, departed from such user expectations. John Windolph, executive director of mar-

keting and communications at Iridium, worried that the phone's contrary qualities might detract from the appeal of the service and noted: "It's huge! It will scare people. It is like a brick-size device with an antenna like a stout bread stick. If we had a campaign that featured our product, we'd lose."[15] The marketing campaign calibrated its efforts to focus on the service ("freedom to communicate") and the presumed psychology of potential subscribers—global elites who feared being out of touch as they were on the move. The focus primarily was to establish Iridium as a brand and a service that spoke to this worry. But this framing mirrored the business plan emphasis on the elite traveler market, rather than on the military or a variety of industrial markets such as oil or mining. The relevant comparison for these latter users was the satellite phone developed by Inmarsat, a hefty briefcase-sized device. For such prospective users, the Iridium handheld phone promised convenience and relative ease of use, especially in field conditions. This tension among relevant markets, those most likely to establish Iridium as a going concern, became a key issue through the first months of operation.

Yet with the significant increase through the 1990s in the geographical reach of terrestrial cellular service beyond metropolitan islands and the downward trend in cellular equipment cost, Iridium could not be certain who might subscribe in what was known as the "horizontal market." Multiple marketing studies through the 1990s had offered assurances that there were more than enough potential consumers, especially in the largest market category of well-to-do international travelers, to make the venture a financial success. Such expectations filtered down into elaborate technical protocols on how to manage user demand that exceeded the traffic capacity of the system.[16] These marketing studies were not mere intellectual exercises, but were tied to a detailed analysis by major US and European banks of Iridium's creditworthiness. The studies became the core determination as to whether the company was deemed a suitable lending risk.[17] Indeed, in early December 1998, after usual procedures of due diligence, including an assessment of the market, Chase Manhattan Bank and Barclays de Zoete Wedd (or BZW, the investment division of Barclays Bank, United Kingdom) arranged a "bank facility" of $1.65 billion—a line of credit to consolidate prior loans and provide operating expenses for the months ahead.[18]

But the November 1998 inauguration of service brought the analytic speculations of the marketing studies in contact with the real world. Might an executive earning several hundred thousands of dollars purchase the comparatively bulky $3,000 phone, or would his company? Accept $3 to $7 per minute charges for

calls, even with a write-off as a business expense? How many executives or kindred global travelers worldwide really wanted or needed the service? Iridium had to rely heavily on its gateway partners for marketing and sales support. Would the gateway partners get the necessary state regulatory permissions that would enable the service to seek customers or support international users transiting their territory? Once this structure had been arranged, could they provide the required marketing and sales support? Would the gateway partners make arrangements with existing businesses in their area to not only stock phones but also willingly sell them? Arrange for collaborations with existing cellular services to integrate Iridium into their network to allow smooth interconnection between terrestrial roaming and satellite communications? A key element of Iridium's pitch was that the service was a complement to existing infrastructure rather than a replacement. For example, the Russian and Chinese gateways, especially, had not met these objectives or even arranged for all the necessary government approvals for commercial service or to bring phones in and out of the country.[19] In the multitude of details to implement the service from the global to the fine-grain of many locals the task now was to identify and meet whatever consumer demand existed.

Through the summer of 1998 and the early months of 1999, answers to these questions quickly and emphatically emerged. At the height of the marketing campaign in the summer of 1998, about one million sales inquiries came into Iridium's sales offices and were forwarded to Iridium's gateway partners. Many of them were expressions of curiosity, with only a small fraction representing those who might well purchase the service. Not surprisingly, then, some at Iridium thought the marketing campaign a wasted effort. Mark Gercenstein, senior vice president of business operations, assessed that "most of the leads that came to us, we found out weren't leads but people just inquiring about the phone. LLC said, 'We're getting all these leads,' but ninety-nine percent of them were just phony, schoolkids calling about doing a paper, you know, just crap leads."[20] Apparently, even of the good leads many languished, without attentive follow-up. With few trained sales people in place and with minimal networks of retail suppliers lined up, most gateway operators were unable to pursue the inquiries in a timely manner. A seemingly promising wave of consumer interest faded when gateways could not effectively respond and translate initial inquiries into sales.[21] In short, the fine-grain of the global—the multiple locals that composed Iridium—was out of synch with the more readily graspable sense of the global found in Iridium's advertising and in its planet-embracing technology.

Such behind-the-scenes troubles, presumed to be solvable in the context of the venture's many successes, were given scant visibility in Iridium's public relations messages as the system officially launched:

> After 11 years of hard work, we are proud to announce that we are open for business. Iridium will open up the world of business, commerce, disaster relief and humanitarian assistance with our first-of-its-kind global communications service. . . . The potential use of Iridium products is boundless. Business people who travel the globe and want to stay in touch with home and office, industries that operate in remote areas—all will find Iridium to be the answer to their communications needs.[22]

With the Iridium system finally up and running, many financial analysts issued "buy" recommendations for Iridium stock, predicting yearly revenues of $6 to $7 billion within 5 years. But even within Iridium, such affirmative pronouncements met with a more complex reality. Through the summer of 1998, the satellite constellation and gateways had undergone an "alpha test" to assess the technical performance of the system. In the early fall, before commercial operation, Iridium conducted a "beta test," the aim of which was to further test the technology but also to gauge consumer experience with and acceptance of the service. Both revealed problems: from dropped calls, to poor voice quality (in comparison to cellular performance), to limited enthusiasm to purchase the service. Compounding such performance issues of the overall system, Kyocera, an investor and major supplier, was unable to finalize its phones for production and delivery, making a full commercial rollout of the system in late 1998 impossible.[23] Not atypical in the reports from the beta testing in different locales, the Brazilian gateway gave the service very low marks, but wanted to keep the test phones as they were being used for negotiations between the Brazilian president and guerilla fighters in the Amazon, a marker of the multiple ways in which the communications infrastructure might be used.[24]

In December 1998 and January 1999, the crosscurrents in the project, shifting between positive and negative valences, were evident. Key members of Iridium's management such as CEO Edward Staiano and CFO Roy Grant presented a measured picture of Iridium's status. The seeming strengths of the venture were not insignificant. As noted, Iridium had made arrangements with a major bank facility, providing access to $1.6 billion in funds, almost half of which was guaranteed by Motorola. In addition, Motorola agreed to defer $400 million in fees Iridium owed it for the Operations and Maintenance Contract, a contract that paid Mo-

torola for tending and operating the satellite network.[25] The contract, binding for five years, was a major expense—through 1999 alone it required Iridium to pay Motorola more than $500 million.[26] The contract and the financial deferral were indicative of the tangled relationship between Motorola and Iridium: Motorola, in essence, was helping Iridium to pay Motorola, which saw equipment sales and services as a critical revenue stream in distinction from any profits it might derive from its investment in Iridium. Another source of financial wherewithal was a further public offering of stock in mid-January 1999, which netted $250 million. At the January board meeting, the directors felt comfortable approving a budget for 1999 totaling more than $1.7 billion, which still enabled the company to set aside about $600 million in reserve funds. From a funds on-hand or accessible perspective Iridium's condition looked solid. This forward-looking view was evident in a couple of other actions taken at the January board meeting: budget line items to fund a "next generation" satellite constellation to supplant Iridium (with emphasis on data and more robust telephony services that approximated terrestrial cellular capabilities) and to purchase a communications company that provided airline in-flight telephone service, a nod to the ongoing belief that elite global travelers still were the critical market.[27]

Just before Christmas 1998, Staiano issued one of his weekly letters to staff on the critical tasks that needed attention. Earlier in December, he had solicited from the gateways their projections for sales into 1999. Uniformly, across the gateways, expectations for sales were substantially below the target numbers that were required by its most recent bank facility.[28] The pressure was on: the billion-dollar plus bank facility Iridium just had garnered gave the company the wherewithal to sustain the business, but contained a clear table of targets for numbers of customers and revenues (which also were related to minutes of phone usage). In late January 1999, Iridium held a news conference to discuss its earnings for the fourth quarter of 1998. Staiano emphasized the positive, minimizing the on-the-ground sales challenges at many gateways:

> In the fourth quarter of 1998, Iridium made history as we became the first truly global mobile telephone company. Today, a single wireless network, the Iridium Network, covers the planet. And we have moved into 1999 with an aggressive strategy to put a large number of customers on our system, and quickly transform Iridium from a technological event to a revenue generator. We think the prospects for doing this are excellent. Our system is performing at a level beyond expectations. Financing is now in place through projected cash flow

> positives. Customer interest remains very high and a number of potentially large customers have now evaluated our service and have given it very high ratings. With all of this going for us, we are in position to sell the service and that is precisely where we are focusing the bulk of our efforts.[29]

Grant added to this positive narrative, detailing the corporation's seemingly solid financial condition, bolstered by actions over the prior several weeks:

> Last week Iridium raised approximately $250 million through a very successful 7.5 million share public offering. This offering had three major benefits. It provided $250 million of cash to our balance sheet. It increased our public float to approximately 20 million shares. And it freed up restrictions placed on $300 million of the $350 million of Motorola guarantees. These restrictions were placed on that particular level of guarantees by our bankers in our $800 million secured credit facility. With this $250 million, combined with the $350 million of additional guarantees from Motorola, this means we have approximately $600 million of funds in excess of what we need to break cash flow breakeven. This provides a significant contingency for the company.[30]

Yet underneath this seemingly good news, the problem of slow sales and their legally binding relation to Iridium's bank loans was undermining Iridium's possibility for success. The slow sales were the result of a series of interlocking problems, already mentioned: the delayed readiness of the satellite constellation (from September to November); performance problems with the telephony, such as dropped calls and poor voice quality; lagging availability of handsets; differing performance of the Motorola and Kyocera handsets; and a host of issues with many of the gateways in getting through all the steps required to sell to and service customers. Staiano's claim that "we are in position to sell the service and that is precisely where we are focusing the bulk of our efforts" was only partly so—the first part was only marginally correct, and the latter was true but not easily resolvable. In the minutes from a board meeting in January 1999, the directors alternated between the competing narratives of their business situation, of their affirmation in financial markets versus the troubles on the ground at many of the gateways and with the overall quality of the service.[31] But despite the positive tenor of the public pronouncements, the hard reality of the numbers specified in the bank covenants had become insistent. A month had passed since Staiano's December inventory of sales accomplished by the gateways; just over two months

remained to meet the first requirement of the bank covenants: by March 31 have 27,000 subscribers and $30 million in revenues.[32]

Beneath the smooth prose of board presentations, the angst was rising. Sue Kennedy, who would replace Mauro Sentenelli as vice president of marketing later in the spring, took notes on a meeting of the gateway CEOs on January 18, just prior to the board meeting. Staiano seemingly alternated between berating and exhorting the gateway CEOs—the frontline in generating sales for the venture. He claimed that an "excuse culture" existed, but not clarifying (at least in Kennedy's notes) whether this was a problem of the gateways or of Iridium in its entirety.[33] He expressed "great frustration we are *not* selling [emphasis in original]" and exhorted the CEOs that "we have to find a way to get these subscribers."[34] But the struggle to meet the bank covenants occurred against an even greater diminishment of prior expectations. As Iridium first sought debt financing in the mid-1990s, the corporation developed a series of business plans (dubbed in sequence 1.0, 2.0, 3.0). These provided necessary scenarios and details for how the corporation could pay back its financiers, but they also were aspirational documents, showing how each challenge of the venture would be met operationally and lead to success.[35] Each plan included an ever-greater level of detail, engendering an increasing sense of what Iridium could accomplish as a global business. From Business Plan 1.0 to Business Plan 3.0, the expectation for numbers of subscribers by the end of the first quarter of 1999 went from 54,000 to 189,000; for the second quarter from 176 to 271,000; with 3.0 forecasting more than 500,000 for the first full year of operation. In the bank covenants and the business plans, such subscriber expectations were coupled with revenue projections. Here, too, unsurprisingly, as the January assessment began to detail, the required numbers seemed out of reach.[36] As the shortfalls became evident from December through January, the difficulty of reaching sales figures and incoming revenues even at the levels required by the bank covenants (set as one-half of anticipated subscribers specified in plan 1.0) registered as a fundamental unraveling of the expected narrative.[37]

But within such a summary of challenges, the particulars of the global in Iridium, the crosscurrents among its many actors, did not get expressed. But through numerous exchanges among the Iridium management team, Motorola, and the gateways, the various disconnects, as outlined above, came into sharper focus. Even though, for example, at the January board meeting the Iridium manager responsible for gateway affairs laid out in a "Market Readiness Review" the stark

realities of lagging sales and revenues, seeming fictions persisted: that the gateways, by their own individual estimations, would generate more than 120,000 subscriptions (across all Iridium services, to include paging and use of the phone simply as an anywhere-in-the-world cellular device) by the end of March 1999 and nearly a million by the end of calendar year 1999. Then the same report shifted back to the realities, exhorting the board (especially its gateway investors) to meet the bank covenants by committing to a new "target plan," which set aside the high expectations of the most recent business plan. Its imperatives included the following: "focusing on the *Vertical Market* is the only way to achieve revenue goal"; "an immediate *plan* must be undertaken to achieve the Target Plan; and "every gateway needs to *act now*" (all emphases in original).[38] Beyond capturing the obvious urgency of the situation, these points exposed two critical fault lines in the project: a reversal of the prior, presumed higher value assigned to sales in the horizontal market (elite travelers) as compared to users in industries such as mining, oil, and coal (examples of the vertical market), and the inability of the gateways to perform sales and distribution responsibilities. As the "*act now*" exhortation suggested, it was a statement of frustration, not a methodology for each gateway to address a set of local problems that ranged across staffing, regulatory permissions, licenses, and relations with service and roaming providers.[39] Such an imperative also reflected the hierarchical character of the relation between Iridium management and the gateways, in which a US corporation aimed to direct the activities of local non-US entities, differently situated culturally and politically.[40] Staiano captured the dynamics of these relations in his own presentation, invoking the paternal-like language of "stick" (violation of the bank covenants, resulting in a capital call from the investors) and "carrot" (a boon to the company's fortunes in the US stock market) as a way to push the gateways to action.[41]

With such high stakes and in such a charged atmosphere, the perception grew that some of the gateways were not motivated to meet their commitments. As noted by Gercenstein, "The trouble [was] that later on there was such lack of evenness in terms of [readiness]. The Japanese were done, ready, early. The Arabs were late. So these guys couldn't invoice and bill, and this area was closed off because you couldn't do that. So that was a problem. That was a real problem for us. But the thinking was correct. We just didn't understand the dynamics of working with these guys, because we were all working on the assumption that having invested $2 billion of their own capital, these guys would be motivated to do the right thing. Wrong answer. They were motivated by what suited them that par-

ticular day."[42] That tough final sentence stood as an indicator of the cultural and political differences the venture had to overcome in patching together a global service with multiple gateways.

But the issues were not all on the side of the gateways. As noted, the availability of handsets and the quality of their performance hindered the ability of Iridium to begin commercial service in the fall of 1998. Motorola phones had some glitches, but Kyocera handsets had a host of issues, primarily related to software, that plagued their readiness for commercial use well into April 1999.[43] This stood as an embarrassment for Kyocera, one of the major investors in the venture and a close business ally of Motorola. This single issue, conjoined with the problems at most of the gateways, derailed the expectation that sales in November and December would provide a substantial beginning to meeting not only the bank covenant requirements for March and June 1999 but also the much higher aspirations of the most recent Iridium business plan. The time window for success thus relentlessly contracted—with none of the core problems easily resolvable.

The Kyocera issue highlighted Motorola's positioning in the global entanglements built into Iridium. As the only supplier of a workable handset, Motorola had to calibrate its interests: Was their critical objective to make as much money as possible off sales of handsets to the gateways (by setting a high price per unit), or to price the units so as to drive sales for the fledgling service? This question was another manifestation of the company's often contradictory involvement in Iridium, seeking both to maximize sales of equipment and services to its start-up and to see it succeed in the marketplace. In January, at the same time as the board meeting, Iridium Chairman Robert Kinzie sent a letter to Motorola CEO Chris Galvin (son of Motorola scion Robert Galvin) and John Mitchell seeking "assistance and attention at the highest corporate level." In addition to asking Motorola to involve its own equipment sales force in promoting Iridium subscriptions, Kinzie sought to have the company adjust the price of the handsets, set at $2,050. But in Iridium's franchise structure, with units passing through a gateway and a sales provider before reaching a customer, the cost of a phone often exceeded $3,000, hindering the attractiveness of the service, especially when compared to typical cellular. A substantive reduction in the base price might reduce "sticker shock" and facilitate sales. As Kinzie noted, "Motorola will make its money from the sale of airtime minutes and the success of Iridium . . . gateway revenues and handset revenues pale in comparison."[44]

But the issue apparently was not so clear-cut from Motorola's perspective. On January 18, the head of the Motorola unit that managed the handsets sent Mitch-

ell a memorandum detailing the background to contractual commitments of Motorola, Iridium, and the gateways. It emphasized that the gateways had agreed to purchase by December 31, 1998, 100,000 handsets and that if the gateways did not meet this obligation, Iridium would have to. Additionally, the contract did not allow gateways to change the number of handsets ordered or to extend delivery beyond December 31. Because of all the problems already described, orders from the gateways only totaled 35,000. The memorandum, though never stating so explicitly, aimed to prioritize Motorola's interest in equipment sales (as embodied in the contract) over the circumstances Iridium confronted in January and the need to find remedies, in which Motorola's participation was critical.[45] Though such details seem a kind of bureaucratic "inside baseball" they were representative of the multiple frictions between parochial and local interests and the global as a category of market opportunity.

This was captured in a February 1999 letter from Hasan Binladin, a principal in the Iridium Middle East, to Staiano, in which he expressed concern with sales performance and linked it to phone prices and call charges.[46] In understated fashion, he reiterated what had been the main topic at the January board meeting: that sales were "way below expectations" and it was "very alarming that after 3 ½ months of commercial activation . . . we are in a situation where the average sales result for all gateways is less than 3% of target."[47] Binladin touched a main nerve of the Iridium narrative, sharing that he had been assessing the horizontal market in the Middle East, talking with those "high income international professional travellers" that were central to the Iridium business plan. Their frame of reference, he reported, was the extant terrestrial cellular market; they regarded the Iridium phones and service as "way over-priced beyond any margin that one would allocate for the inherent satellite technology." This applied not just to those mobile, elite individuals but to well-heeled oil companies such as ARAMCO, which had reduced its commitment to purchase 2,000 phones to 140. Seeing the phone price as a critical barrier to initial adoption of the service, he argued that the price should be set at the comparatively much lower level of $750 to $1,000 and that in conjunction usage rates should be lower, too. He concluded that Iridium management and the gateways needed to "avert running into a situation where poor marketing strategies may cause the collapse of a technically superior investment."[48]

In India the situation was similar, but somewhat different. As presented by the Indian gateway representative at the January board of directors meeting, the main impediments concerned a range of bureaucratic matters relating to tariffs,

type approval of communication devices, license fees for use of radio spectrum, and other issues. Arrangements, too, had to be made for the levy of taxies in large metropolitan areas such as Mumbai and Delhi for connecting to the public switched network. Though Iridium had apparently generated "positive coverage in the press," the gateway foresaw a "slow ramp-up in the individual subscribers." But capturing the vast difference in wealth and its meaning across Iridium's gateways, the presenter matter-of-factly noted that the "landed cost [after mark-ups of import fees] of an Iridium handset [was] greater than the price of a compact car (a Japanese Suzuki)."[49]

Such comparative valuation highlighted the "upper end" character of the Iridium service generally, regardless of economic setting. A 1997 marketing study found that Iridium usage charges "seemed excessive to Chinese, steep to Argentines but bordered on reasonable to Americans and French."[50] But usage charges were not solely set by corporate Iridium; each gateway could establish its own rates (above a baseline rate) to accommodate regional politics and economic circumstances. Calls originating in Africa and India had the highest rates (well over $7 a minute); calls from North America and international waters the lowest ($3 to $4 a minute).[51]

This structuring of costs, on one level, provided valuable revenue to developing countries, on the model of the era of regulated telephone systems. But on another level it mirrored existing global structures of inequality. This was evident, too, in a study of Brazil that noted that the country's "fast growing economy and position as the largest state and economy in South America attracts significant business travel from abroad; several multinationals have significant operations (e.g. auto manufacturers)." Such qualitative assessment fit Iridium's broader narrative of mobile elite economic activity. But the report also reflected on Brazil's internal elite / non-elite disjuncture: "Brazil has one of the highest income disparities in the world. There are many rural rich farms and ranches located outside cellular and even wireline coverage areas." From a marketing point of view, the aim was to take advantage of this situation, not alleviate it, especially as "pent-up demand . . . makes cellular a status symbol, as in many other developing countries. . . . High-end products such as Motorola Star-Tac 'fly' off the shelves even at prices of $2000–3000."[52] As such reports suggest, the reality of the conditions in developing countries gave an odd cast to Iridium's marketing effort and its attempts to sell the service. The studies recognized the venture's complicated politics, but at the same time attempted to minimize their deep implications for making the business viable. The actualities of developing world conditions and their distance from neoliberal optimism was a constant tension.

But frictions and problems arose elsewhere as well. Even when a handset found its way to a customer the experience often was unsatisfactory. As part of beta testing of handsets and the satellite constellation in September and October 1998, Iridium's market research department conducted focus groups "to assess the usability of the Iridium User's Guide, Access Number Guide and Quick Reference Card." The study selected only "educational professionals" and found that "using the Motorola satellite phone correctly is neither intuitive nor easy." Most were not sure "how to turn on the phone, position the antenna and place a call" even with the aid of the user documentation.[53] Such findings undermined the core assumption of the venture, in which sophisticated, elite travelers, presumably already savvy in their use of cellular telephony, could readily integrate Iridium into their communications options. This issue persisted and was still given emphasis as a problem in status reports at the March board of directors meeting.

Equally problematic was the performance of the satellite constellation itself. Motorola and Iridium testing of the system, in its beta phase and after commercial activation, showed steady improvement in performance for indicators such as incidence of dropped calls or quality of the audio. But reports from the gateways as they worked with customers gave a much less favorable account. In mid-January, the Korean gateway sent a several-page report detailing the ways in which "the actual level of quality claimed by customers are too far lower" than that presumed by Iridium. The report, almost apologetically, noted that "up to now we have offered trial or solicitation of subscription carefully to who needs Iridium in remote areas (e.g. Russia, Myanmar, African nations) only. However, we are compelled to hesitate to approach somebody else whose rationale for Iridium is less than the former. What we are afraid is how to minimize the number of 'bad mouths' rather than how to increase the number of subscription under those quality level."[54] The result of the initial rollout in Korea was that pre-subscribers, already relatively few in number, were reducing or cancelling their initial commitments, some because of handset size and others because of quality. As examples, the report cited the retraction of a government order of 40 phones and pagers and the complaint of a businessperson that it was "hard to make a call at the mountain in Russia." Issues of quality overlapped with the non-availability of handsets, the report complaining that "we have lost our faces against customers in ensuring the supply timing of handset and other equipment." The writer summarized the effect of these various problems: "the more subscribers we have, the more bad mouths we have to be afraid of. Regardless of vertical or horizontal, the bad mouths will be transmitted too fast among our target customers." The report

concluded bluntly that the gateway could not meet its sales forecasts because of the lack of "stable and reliable constellation, network and service. None of the sales person nor sales agent for Iridium Korea has minimal confidence in offering a trial of Iridium to potential customers. The level of call completion and convenience is far from being we originally expected."[55]

Despite the imperfect English, the experience of the Korean gateway was not atypical. In mid-February, North American gateway users reported a number of frustrations. The handset would receive a signal of "busy" from the network for "no apparent reason," requiring the user to turn the phone off, then on. Equally problematic, and a more common problem, was that voice quality was poor, often characterized as having a "digital warble." At the January board meeting, system administrators claimed this happened on less than 10 percent of calls; users reported its occurrence 40 percent to 50 percent of the time. This was distinguished from the additional problem of acquiring a "weak signal."[56] By mid-March, such issues seemingly remained unresolved. In response to a complaint from the Taiwan gateway on handset and system performance, an Iridium troubleshooter advised that

> for the past few months, all reports indicate that the ISU [the handset] works pretty well when it is used *properly*. That means using the ISU where it has 360 degree line of sight. Using the example of the golf course—don't demo it inside the clubhouse or under a big tree. It also means that if you want to sell it to people who spend some amount of time in cities and towns where are there obstructions—YOU MUST DEMO IT AND SELL IT AS A DUAL MODE (satellite and cellular) PHONE! (I will fax you an article about testing the handset in the Amazon jungle and it is a good example of the need to educate our subscribers on how to use the handset). . . . If we all work together we can make Iridium a success![57]

Yet even with such a "can-do" attitude, the sales numbers Iridium and the gateways generated fell woefully short of the bank covenant requirements looming at the end of March. Near the end of January, the venture registered a mere 4,249 subscribers. New subscriptions were coming in at a rate of 104 a day, which seemed promising if sustained.[58] But 6 weeks later, in a March 15 summary of sales, the pace and number of subscriptions remained weak: a total of 7,304. As a result, in early March, with sales figures substantially below the minimal bank covenant requirements and spectacularly less than the expectations of the business plan, Iridium began negotiating with its bank creditors to rework the

terms of its loans. At the same time, John Mitchell, the "godfather" who for years supported and protected Iridium at Motorola, wrote a long letter to Staiano. Although containing notes of optimism, it read like an elegy—certainly for Staiano's tenure as CEO and seemingly for Iridium itself. Measured and polite, the letter summarized the obvious and multiple missteps of the enterprise. "Simple arithmetic," Mitchell wrote, "says, with our current customer growth, no matter how much they spend per month, or per year, we will not reach the financial targets." As the testimony and critiques provided by the gateways indicated, "an Iridium sale is a new concept sale" for "customers who can best use the Iridium service live in or travel to remote areas"; what was needed were "more sales people who can make a knowledgeable, persuasive presentation" to such potential customers.[59] The venture's most important management protagonist laid the Iridium narrative to rest. The vision of broad market appeal, of a clientele of international elites driving the success of the company was gone. Not least, the financial and organizational structure developed on that premise, implicitly would soon be gone as well. The vision of the global embedded in Mitchell's words though also rooted in the transnational movement of elites and of global capital flows was more bounded, less ambitious in speaking to a global cultural and economic order. Much of the rest of the letter provided avuncular suggestions on reorienting the marketing and sales methods. He praised the "ad program" (covered in chapter 4), offering that he was "sure it made selling Iridium stocks and bonds an easier task." But now is the time "for a change to a program that helps a prospective customer visualize specifically how Iridium could make his business more efficient." This stood as a gentle way of saying that Staiano no longer fit the needs of the company; in fact, he would be forced out a few weeks later. To soften this implication, Mitchell noted that "yes, all of us have egg on our faces; manufacturers, gateways, Iridium investors, and LLC [Iridium]. The gap [between plans and actual sales] is very substantial. The biggest egg may be in the optimistic planning, which we all seemed happy to accept." He nostalgically reflected on the original Private Placement Memoranda (PPM) of 1991 and 1993 (covered in chapter 3). He lamented that "in hindsight I'm not sure that market research and forecasters appraised the time it takes to sell a new concept like Iridium. . . . We repeatedly rationalized [the market] since we were looking for only 1 or 2% of the project cellular population. We rationalized that the cellular providers would quickly compete with each other to snatch up Iridium as a wonderful addition to their cellular offering."[60] Oddly, Mitchell's multi-page letter made no mention of the banks and any "egg on the face" they might bear, given their relation to the

enterprise, then and in years past. They controlled one of, if not, the key variable for any future that might be salvaged: time to refashion Iridium, even to Mitchell's more limited vision of what was possible.

Also not mentioned was a potential plus to Iridium, long in the planning: the role of potential US government purchases and revenues, which potentially could provide a financial base for the company. As noted previously, a separate gateway was built to serve exclusively government communications through the system—primarily for military and State Department personnel. But a contract, through the Defense Information Systems Agency (DISA), did not get finalized until early April 1999.[61] On the surface it seemed an answer to meeting the bank covenants; the contract had a potential value of $219 million through a 3-year period, with airtime usage set at up to 28 million minutes per year. This was a revenue stream that if realized would have met a substantial fraction of Iridium's short-term revenue needs. But the contract amount only was in the DISA budget, not fully funded. Thus, the contract offered less than it seemed. With Iridium's financial difficulties in the news, some government users expressed reluctance to take up the service. The State Department asked for a detailed response "to counter negative press and dispel Iridium solvency, Y2K, and system operation and availability issues."[62] It seems that Y2K became a critical concern in the implementation of the contract, with some uncertainty as to whether the Iridium system was fully compliant, thus delaying the government's commitment at a crucial stage for the venture.[63] Not only was this a setback in itself, but, by example, it made other governments less willing to commit to large contracts with the venture.

As Iridium's rollout and initial performance drew public attention, the vagaries of large, long-term technology projects became one line of commentary. Even in the *WIRED* article that touted Iridium as the vanguard of a move toward pan-national corporations, such caution caused the author to leaven his enthusiasm:

> "This system does not let you do what a lot of wired people want to do," cautions Professor Heather Hudson, who runs the telecommunications program at the University of San Francisco and studies the business of wireless communications. "Nineteen-nineties technologies are changing so fast that it is hard to keep up. Iridium is designed from a 1980s perspective of a global cellular system. Since then, the Internet has grown and cellular telephony is much more pervasive. There are many more opportunities for roaming than were assumed

> in 1989. So there are fewer businesspeople who need to look for an alternative to a cell phone while they are on the road."[64]

Toward the late 1990s, some industry observers felt Motorola had additional incentive, over and above its investment, to ensure that Iridium succeeded—to protect its reputation for technical and business acumen.[65] Between 1994 and 1997, Motorola had suffered slowing sales growth, a decline in net income, and decreasing profit margins. Moreover, the company had experienced several previous business mishaps, including a failure to anticipate fully the cellular industry's switch to digital cell phones. Motorola had lost its late 1980s master-of-technology luster and its aura of financial solidity, all of which initially had made Iridium seem an adventurous yet plausible project for the corporation. By late 1998 and early 1999, with its own changed circumstances, its commitment to the project was less certain and Iridium itself seemed to shift from corporate asset to liability. The framing and tone of Mitchell's letter to Staiano fit such changed circumstances.

Failure to meet the seemingly modest targets of the bank covenants set in motion negotiations with Chase Manhattan and BZW, which in turn eroded investor and public confidence in the project. The underlying issue was less about the market as an abstraction than the readiness of Iridium and its gateways to be in a position to meet these milestones of revenue and subscribers—to handle the fine grain of work required in the global project and to make a global technical system function smoothly on a short timescale. As the quarterly subscriber targets for 1999 suggested, whether assessed by the bank covenants or the Business Plan 3.0, the venture was predicated on a particular analogy: the prior performance of the cellular phone market, for which uptake followed a bold "hockey stick" curve of relatively rapid market adoption. The market that Motorola perceived in the early 1990s was not the market that existed in 1998 and 1999—neither in terms of cellular as a model nor in the attractiveness of the product to "high-income" and "business traveler" clientele. Ten years before there had been little competition in the type of cellular service Iridium offered, nor did communications modes, such as the Web, loom as alternatives. Nor, importantly, did those models depend on the existence of a fully functioning transnational framework of business operations. Their development was incremental, not global in one dramatic swoop.

As Iridium's precarious position became public, the company cited the main cause of the shortfall in subscriptions as a combination of an inadequate supply of phones, erratic performance in the combined system of satellites and gateways,

software problems, and, most often referenced, a lack of sales channels with properly trained personnel at the gateways. The latter problem had haunted Iridium during the two years prior to launch. By early 1999, the company accepted that the commercial prospects of the venture required it to train a sales staff, not leave this task to the gateways. The company itself would have to work with local cellular sellers and providers in each gateway territory. Such a revelation left banks and holders of Iridium stock in an awkward position, dependent on Iridium to fix the critical problem of distribution and sales in the months after, rather than before, service began. Embedded in this problem, as indicated by Mitchell's letter and critiques from the gateways, were the questions of who were the most likely potential customers—a swath of the global, mobile professional elite or the less numerous, more task-driven professionals in the vertical market?—and how to tailor sales tactics to their needs.

From the vantage point of early 1999, Iridium's business plan—or at least its execution—appeared fundamentally flawed. The original plan specified that the consortium of gateways market and sell the product prior to the onset of commercial operations through regional cellular retailers and cellular service providers. As already noted, more than a few of the gateways were not staffed or sufficiently adept in modern business practice to accomplish these objectives as Iridium launched. China and Russia, with their state-centric economies, were especially problematic. Even at those gateways more prepared for these responsibilities, selling the service from advertising and informational brochures, without person-to-person sales support, proved nearly impossible. The service plans were complex (different combinations of satellite. terrestrial, and pager options), as was the equipment offering—and not least the phones and the service were expensive. In mid-March, a service provider for Iridium North America, considered along with Iridium Japan one of the two most competent gateways, wrote ruefully to his Iridium counterparts that "the sluggish product launch suggests the market is not as large as the research gurus initially indicated. . . . The airtime is too high and equipment pricing needs to be under $2K . . . [and] still there are problems with the Iridium network."[66]

As weaker-than-expected subscriber and revenue numbers settled in, Iridium stock, which had traded as high as $73 per share, dropped to $20 in early 1999. The plunging stock price only exacerbated the tensions in the venture; without the possibility of reaching the "carrot" of higher stock valuation, the financial incentives for the gateways collapsed and with that the glue that held Iridium together as a global vision and undertaking. As these cracks in the enterprise

unfolded, the corporate financial officer Roy T. Grant resigned, with Ed Staiano soon following, forced out by the board at an April 22 meeting. His assertive style of management, long a sore point with non-US members of the board, seemed the wrong fit to rescue the company—a conclusion Mitchell had reached in early March. As a cost-savings measure, Staiano aggravated his old Motorola colleagues by seeking to reduce by 50 percent its lucrative $500 million operational and maintenance contract with Iridium, payment on which it already had deferred as an act of good will to facilitate the commercial rollout. These departures, and the tensions associated with them, placed further pressure on the company.[67]

John Richardson, the CEO of Iridium Africa Corp., one of the investors in the company, was appointed interim CEO after Staiano's departure. Richardson's expertise prior to Iridium was in corporate restructuring and thus seemed a fit for the distressed company. For the quarter ending in March, Iridium reported a net loss of $505.4 million, or $3.45 a share. The stock fell to $15.62 per share. One of Richardson's first tasks was to revamp Iridium's marketing strategy along lines that already had become clear. According to Richardson, as the crisis took hold, the message about the product and the market changed from meeting to meeting: "One day, we'd talk about cellular applications, the next day it was a satellite product. When we launched in November, I'm not sure we had a clear idea of what we wanted to be."[68] The quote itself reflected the problem: Richardson had been part of the leadership team that defined the marketing message he subsequently so casually critiqued. In April, Iridium officially announced that it could not meet the targets specified in the bank facility. Chase Manhattan and BZW granted Iridium a two-month extension. The stock dropped to $10.44 per share, as Motorola hinted it might withdraw from the ailing venture. Wall Street began talking about the possibility of bankruptcy. But Iridium stated that it was revamping its business plan and by month's end hoped to have charted a new course for its financing. A vicious cycle was well under way.

Iridium received extensions on debt payments, perhaps in part because the lending community knew that moving from a high-technology concept to an operating business, especially one of this scale, might well encounter difficulties—that the assumption of a "hockey stick" take-off upward sales trajectory might require more time to manifest. But the main reason banks and creditors granted extensions to meet loan terms was because bankruptcy did not yet seem a viable alternative. The equity partners in Iridium owned all of the gateways (they were corporations, distinct from Iridium), all distribution, and all national regulatory licenses. If the banks and creditors forced Iridium into bankruptcy, they could

end up owning a satellite constellation unable to interact with the gateways or terrestrial public switched telephone networks (PSTNs). Iridium received an additional 30-day extension on its loan facility from the banks, beyond the prior 2-month leniency, and, in addition, received an extension until June 30 on a separate $90 million payment to bond holders. By late spring, Iridium let go 15 percent of its 550-employee workforce, including senior staff. The stock had sunk to $6 per share and Iridium bonds were selling at 19 cents on the dollar.

Though the Iridium board of directors tasked Richardson to solidify and improve Iridium's financial position, he spoke as if the outcome was already set:

> We did all of the difficult stuff well, like building the network, and did all of the no-brainer stuff at the end poorly. Iridium's major mistake was a premature launch for a product that wasn't ready. People became so obsessed with the technical grandeur of the project that they missed fatal marketing traps. . . . Iridium's international structure has proven almost impossible to manage: the 28 members of the board speak multiple languages, turning meetings into mini-U.N. conferences complete with headsets translating the proceedings into five languages. . . . We're a classic MBA case study in how not to introduce a product. First we created a marvelous technological achievement. Then we asked how to make money on it.[69]

The latter part of that statement was not quite true: the question of making a profit was prominent throughout the 1990s, the very point of the numerous marketing studies as well as the core question raised by the financial community as Iridium successfully arranged bond offerings and loan facilities. Richardson's remarks missed in another way: the difficulty in managing the venture's transnational structure was not inherent (an echo of the fractiousness of UN governance) but a historically contingent phenomenon, part of the 1990s fashioning of the global. The key issue in this regard was how to conjoin Iridium's international structure with standards of Western business practice; it was a problem of how to integrate independent local actors, many from developing areas, into a global enterprise. To avoid bankruptcy Iridium needed time to adapt this structure, with its multiple, unwieldy locally specific issues, of merging local ways of doing and capacities into the broader corporate framework of Iridium. But the constraints imposed by the bank covenants and Motorola's reluctance to provide further financial guarantees limited this possibility.

The complexity of the product, as noted above, and the system's halting steps toward high levels of performance thwarted a nimble, quick response, too. Some

industrial customers would take six to nine months to try out any new product, including an expensive satellite phone service. Such issues fed into the time problem from the other direction: why, from the perspective of a prospective customer, purchase Iridium service if the company might be out of business in six months or a year?[70] Although not yet in commercial operation, Iridium's primary competitor, Globalstar, promised to set its prices significantly lower than Iridium's, putting further pressure on the company. Richardson then instituted price reductions of up to 65 percent off the original price for some of Iridium's products and services. The banks and investors agreed to give Iridium yet a third extension to August 11 to meet its financial covenants. Motorola suggested that the venture might need to close and liquidate through bankruptcy proceedings unless a restructuring agreement could be reached. If bankruptcy occurred, Motorola would continue to maintain the satellite network, but only for a limited time period.

Iridium did ask its consortium investors and contractors to come up with more equity, an idea received with little interest. Several partners made it clear that they would walk away rather than provide additional funding—a fissure in the board that limited the options for recomposing the company. All the partners had to be committed to restructuring for any possibility of success; with the deteriorating situation they had become as risk cautious as the banks. Wall Street analysts expected the banks to allow Iridium to reschedule and extend payments on its debt over several years or offer debt holders an equity position in the company. Through this lens, it seemed implausible that Iridium's primary asset, its satellites orbiting the Earth, might be auctioned off in bankruptcy court.

On August 12, 1999, Iridium filed for bankruptcy protection—a dramatic humiliation for a company that a few years earlier predicted financial breakeven in the first year of operations. Instead, it became, at that time, one of the 20 largest bankruptcy filings in history. On August 13, NASDAQ suspended trading in the company's stock, which had been trading for as little as $3 per share. Iridium's partners—who had also made investments by building ground stations, assembling management teams, and marketing Iridium services—had little to show for their equity. Iridium's bondholders didn't fare any better, as $1.5 billion in debt traded for around 15 cents on the dollar as the company entered restructuring talks with its creditors in the bankruptcy process. In a last ditch effort, Iridium reduced phone call prices to $1.40 to $3 per minute and prices of handsets to $1,500.[71]

Within several months, Iridium as originally conceived had slowly then com-

pletely evaporated—its existing business and financial structure beyond rescue. As these multiple problems unfolded through the summer of 1999, Motorola engineers who had invented the Iridium concept and helped bring it to technical reality expressed disbelief that their exemplary work was turning into an epic failure.[72] In August 1999, after Leo Mondale resigned as Iridium's chief financial officer (as successor to Roy Grant), few believed that a successful bankruptcy restructuring was possible. According to one analyst, "if they [Iridium] were close [to a restructuring plan], they wouldn't be bringing in a whole new team." Iridium's failure had a "flu-like effect" (as commentators dubbed it) on the entire industry. ICO Global Communications, another of the original cohort of satellite telephony competitors, also filed for bankruptcy protection two weeks after the Iridium filing. ICO failed to raise $500 million it sought from a public stock offering, a financial step already twice delayed.

Now the only remaining way to save the bankrupt company was through the graces of a qualified bidder as determined by a federal court. This required a bidder to submit a refundable cash deposit or letter of credit equal to the greater of $10 million, or 10 percent of the value of the amount bid to take control of Iridium. According to bankruptcy court filings, Iridium was generating revenue of $1.5 million per month. On December 9, 1999, Motorola agreed to a $20 million cash infusion for Iridium, but even with this the company would run out of operating funds by February 15, 2000. A monthly operating cost of $10 million, an anticipated cost of $300 million every few years for satellite replenishment, and still unresolved questions about the market for the service limited the field of potential rescuers.

The cellular phone entrepreneur Craig McCaw considered a short-term cash infusion as he assessed whether to make a much larger investment to rescue Iridium, emerging as the only credible candidate in terms of both resources and relevant experience. He also led a group of investors who pledged $1.2 billion to rescue the bankrupt ICO satellite system.[73] Although McCaw's proposed restructuring plan was not fully disclosed, it was expected that Motorola's involvement would be that of a minority stakeholder. Also, under the restructuring plan, Motorola would reduce its monthly fee for operating and maintaining the Iridium system from $45 million to $8.8 million.[74]

But the financial failure of Iridium had mixed meaning for Motorola. Its reputation faltered as did its hopes to create a new business niche in satellite manufacture. But bankruptcy was not a complete loss. The firm collected $3.65 billion in Iridium contracts, providing approximately $750 million in profit. Iridium pro-

vided Motorola with more than 1,000 patents in building satellite communication systems, which under more favorable circumstances would have facilitated Motorola's gaining a leading position in the global satellite industry as a manufacturer. Already Motorola had parlayed its Iridium work into a role as the prime contractor to build the Teledesic Project, a 288-satellite constellation to provide Internet services worldwide. Backers of the Teledesic Project, which had a price tag of $15 billion to transmit data, video, and voice, included Boeing, Microsoft's chairman Bill Gates and McCaw, reflecting his broad interest in relating terrestrial and space-based infrastructures of communications.

As an investor in Iridium, Motorola stated that it had no intention of providing additional funding to ailing Iridium, unless of course other consortium members followed suit, an outcome without support. In March 2000, McCaw withdrew his offer to bail out Iridium even at a deep discount, focusing his efforts on salvaging the ICO satellite system instead. In effect, this meant there would be no commercially based savior for the system. McCaw's reluctance, in part, seemed grounded in Iridium's more complex (compared to ICO's) framework of international investment and participation, as well as the system's limited capacity to transmit data.

With the withdrawal of McCaw's financing, Iridium notified the US Bankruptcy Court that it had not been able to attract a qualified buyer by the specified deadline. Iridium planned to terminate its commercial service after 11:59 p.m. on March 17, 2000, a little more than 16 months after inaugurating service, and begin the process of liquidating its assets. Immediately following the Iridium announcement, Motorola issued a dry, matter-of-fact press release, an epitaph on what Robert Galvin had dubbed the "eighth wonder of the world":

> Motorola will maintain the Iridium satellite system for a limited period of time while the deorbiting plan is being finalized. During this period, we also will continue to work with the subscribers in remote locations to obtain alternative communications. However, the continuation of limited Iridium service during this time will depend on whether the individual gateway companies, which are separate operating companies, remain open. In order to support those customers who purchased Iridium service directly from Motorola, Customer Support Call Centers and a website that are available 24 hours a day, seven days a week have been established by Motorola. Included in the information for customers is a list of alternative satellite communications services.[75]

The deorbiting plan would likely take 2 years to complete at a cost of $50 to $70 million. It would include all 66 satellites as well as 22 satellites serving as spares.

The plan called for deorbiting the satellites four at a time by firing their thrusters to drop them into the atmosphere to incinerate—a possibility that inspired (with literary license) a Dilbert comic strip in which satellites were portrayed as descending into backyard swimming pools.

The comic strip was a small marker of the shifting terrain of popular engagement with projects like Iridium. The rise of online forums, through message boards and their kin, attracted enthusiasts, nerds, and small investors to weigh in on the meaning of the venture, whether to hope for its resuscitation or exult in its demise. Supporters of the venture were dubbed "Iridiots" by the more dismissive. "Hard to believe that USG [US government] won't come up with a paltry $5 B when the federal surplus is $200 B." "Maybe this system would have worked on another planet (like Uranus, for example) but there is obviously no need for it here on Earth. Auf widersehn, Iridium."[76] And delightfully on and on. For some reason, as late as May 1999, Iridium staff followed this online world, noting that "the discussions are free-wheeling, and the tone is often sarcastic and highly opinionated, especially when the company reports bad news."[77] All this online democratic ferment led to a grassroots attempt to save Iridium by having supporters send in small contributions with the aim of repurposing the system for a free Internet-style form of communications and community.

But more traditional structures of financial rescue prevailed. In November 2000, a group of investors led by an airline executive won bankruptcy court approval to form Iridium Satellite Corporation and purchase all remaining assets of Iridium LLC—at the fire-sale price of $25 million, amounting to less than a penny on the dollar on the $6 billion plus investment in the original venture. As part of the proposed sale, Motorola would turn over responsibility for day-to-day operation of the system to Boeing, a subcontractor to the new ownership. Although Motorola would retain a 2 percent stake in the new system, it had no further obligations to operate, maintain, or decommission the constellation. Almost immediately after the announcement, and not coincidentally, the DISA awarded Iridium Satellite a $72 million contract.[78]

As noted in prior chapters, the DoD already had a deep connection to Iridium, possessing its own gateway in Hawaii, operated under contract by Motorola. As bankruptcy proceeded, the DoD did not want to lose this global communications capability, in which it had an interest since the venture's initiation. It directly encouraged the formation of the new investor group, promising a contract to give Iridium's new incarnation financial stability—a possibility because the vast structure of debt had been expunged in bankruptcy. This turn tightened the al-

ready strong civil-military connection embedded in the project. Dave Oliver, deputy under secretary of defense for acquisition, celebrated the contract, noting, "Iridium will not only add to our existing capability, it will provide a commercial alternative to our purely military systems. This may enable real civil/military dual use, keep us closer to leading edge technology, and provide a real alternative for the future."[79]

Iridium had been rescued from the brink of extinction—literally. As part of the agreement, the newly formed company acquired all of the assets of the original Iridium and its subsidiaries. This included the satellite constellation, the terrestrial network, Iridium real estate, and the company's intellectual property. Because of the new company's significantly reduced cost structure, it readily developed a workable business model based on military use, through so-called vertical industrial markets such as oil and gas extraction and other specialized uses. In short, it targeted those markets not suitable for the greatly expanded reach of terrestrial or commercial cellular (the military) or still beyond that reach (niche uses). Though Iridium's demise attracted widespread media attention, its resuscitation generated much less interest, leading the *Arizona Republic* (as one example) to run in 2005 an article "Iridium, Alive and Well." Quotes like "Everyone thinks the Iridium satellites crashed and burned, but they're all still up there" enlivened the article's premise.[80] By that point, the new Iridium reported a base of 142,000 subscribers, with the cost of a new phone less than $1,500 and per minute expenses of $1 to $1.60.[81] Yet Iridium did not separate out the numbers of military and commercial users, relevant as the phone service gained widespread use in the Afghanistan and Iraq theaters of war. In those contexts, ironically, Iridium met its original aspiration of providing a communications infrastructure where little to none existed—but, of course, sans the rhetorical aura of satellite communications acting as an instrument of uplift for developing countries and their citizens.

Though after bankruptcy Iridium's news profile faded, one group fixated on the consequences of the company's arc from an object of media fascination to a business failure: the stock, bond, and bank investors that had supported the enterprise. Motorola, as a beleaguered but still prominent company, became the focus of their grievances. At least 20 investor groups filed suit against Motorola and Iridium, citing a range of malfeasance: these included the nature of the Motorola supply contracts that funneled equity, loan, and stock monies from Iridium into the parent company; misrepresenting the robustness of the market for the service; hiding technical problems; and other claims of improper actions.

Eventually, on September 4, 2007, the Bankruptcy Court in Manhattan ruled mostly in favor of Motorola, contrary to the hopes of creditors seeking a $3.7 billion judgment. The judge ruled that even though the capital markets were "terribly wrong" about Iridium's hopes for huge profits, Iridium was "solvent" during the critical period from 1996 through 1998 when it successfully raised impressive amounts of debt and equity in the capital markets. The court said that even though financial experts now believed that Iridium was a hopeless one-way cash flow, with a flawed business model, it abided by required financial disclosures.[82]

Indeed, when in December 1998 Iridium and Motorola closed on a more than $1 billion loan facility with Chase Manhattan and BZW, the prospectus contained a compendium of risks, including a highly leveraged capital structure; design limitations—such as phone size; service limitations—including severe degradation in cars, buildings, and urban areas; high handset and service pricing; the build-out of cellular networks and a lack of control over partners' marketing efforts. All were points of contention during bankruptcy and after during the lawsuits.[83]

The day after the court ruling in 2007, newspapers reported that Iridium Satellite, a privately held company, was preparing to raise about $500 million in a private equity offering to be followed by a subsequent IPO. Although such bravado offered an echo of the mid-1990s, the idea of the global embodied in the project was different, more military-oriented, more cramped as to the ideological meanings of the Earth-embracing communications system and its practical reach. Comparing the Iridium of the mid-2000s with its 1990s progenitor, the bolder, more ambitious worldview of the earlier period stands out. It took on a series of interlocking projects—the redefinition of manufacturing workspace, the creation of the corporate university and new structures of knowledge, culture as a deep problem of the global era, the reorientation of national and transnational structures of regulation, the seeming naturalness of imagining and creating a global infrastructure, and, not least, comprehending and stitching all this together ideologically under the neoliberal banner.

All of these were taken as complementary endeavors explicit in their intention to create the category of "the global," taking that effort as conceptually unproblematic and warranted. To pose it as such is to highlight the preeminent pull in the post–Cold War moment of US elites and power as manifested through the Washington Consensus and through, as exemplified by the Motorola and Iridium case, US corporations. That pull reoriented US institutions such as the Federal Communications Commission (FCC) and on the international stage key forums such as the International Telecommunications Union (ITU). And "pull"

is an apt word as seen through the bevy of non-US investors that participated in the project, spanning across Europe, the Middle East, Russia, China, Japan, and South America. For these nations participation in the venture derived from self-interest, but, too, was inextricably bound to a desire to align with US power, even if cautiously, as expressed through an ambitious high-technology venture. Iridium seemed an opportunity to test collaboration and partnership in a context in which neoliberal markets, shaped by the assumptions of the Washington Consensus, had rapidly become central to geopolitics and constructs of the global—even if seen differently from various national vantages, By the mid-2000s, in a world shaped by September 11, 2001, the nature of that social space had changed, making the military a more visible and more prominent shaper of the global, more deeply entwined with the market.

Conclusion

This account has offered two intertwined narratives. One was to present the global as a category invoked and used by a variety of historical actors in the 1980s and 1990s—a category that was contingent, in process, and given concrete meaning by these actors. The other was the development of Motorola's Iridium venture, a tracer of the multiple problems, strategies, and meanings of creating the global as a historically grounded phenomenon of the 1980s and 1990s. The venture highlighted the period's strong ideological and political commitment to neoliberal markets as the preferred and only engine for creating a beneficial economic and social order. Deeply implicated in this world outlook was the role of technology, as consumer item and infrastructure. Communications advances, especially in computers and satellite applications, stood out as key symbols of a market-ordered, nation-state-facilitated world. In this regard, the venture's history dovetails with the belief systems and practices of a range of period actors. In turn, it coheres with much of 1980s and 1990s humanities literature, which takes as a basic tenet that this political-economic condition is central to an explanation of these decades.

This story, too, brings forward the scholarly question of the role and power of nation-states in this recent history—whether the market turn diminished the power of nations or merely reoriented it through new relations with corporations. Such analytic framing, of course, applies unevenly across the nation-state landscape, with shifting consequence and meaning from North to South, West

to East. But from the US standpoint, the Iridium case shows the broad sweep of government interaction with Motorola and Iridium, both to facilitate neoliberal policy and, on occasion, to delimit it, especially in areas of national security. On different policy issues and actions, Motorola and Iridium negotiated with, worked conjointly with, or lobbied a range of governmental entities—in the executive branch, with departments such as Commerce, State, and Defense; regulatory agencies, especially the Federal Communications Commission (FCC); White House staff; and, not least, Congress. The marshaling of State and FCC support proved crucial not only within the United States for adapting governmental structures for neoliberal policy goals—with legal recognition of competitive, privately organized, global satellite telephony a prime instance—but also in international governance forums. This was immediately relevant for the venture in preparation for and execution of the International Telecommunications Union's (ITU) 1992 World Administrative Radio Conference (WARC). It was, in a broader frame still, also relevant in the 1995–1996 negotiations establishing the World Trade Organization (WTO), in which Motorola and Iridium worked alongside US representatives to achieve policy rulings favorable to their telecommunications and satellite telephony interests.

It was this very period synergy—of a shared belief in markets as the preferred means to achieve social good—among nation-states, international actors, and corporate actors that shaped the 1980s and 1990s global. To state it thus is not to use blithely a largely Western-driven perspective to stand for the larger experience. It is to encapsulate the main dynamic of the period, of US and European political and economic dominance and the ability of these nations to persuade non-Western actors to see the ideology of markets as a better means to fulfill their interests. The way in which African and South American countries came to support Iridium at WARC 92 stands as one indicator, as, of course, did Iridium itself with its array of investors, most of whom were non-Western. For the latter, too, the very structure of that investment reflected that period dynamic in two ways. One was obvious: the basic fact that a major US firm, and its subsidiary, organized this transnational initiative and were positioned to reap the largest benefits should it be successful. But another was subtler. The "united nations" moniker affixed to the venture obscured the working relations between the non-Motorola investors and Iridium, confusing the difference between a forum designed to elevate the political standing of developing nations and a corporate board. The non-Motorola investors were more like spokes feeding into Iridium and Motorola's central core rather than networked to work collectively on any shared inter-

ests; such structural arrangement facilitated Iridium control over the direction and implementation of the project.

Older tools of US power also came into play. The use of the dollar as the currency of international trade shaped details such as how to process the settlement (division of who gets paid how much) of customer call transactions over the system and to do so under the aegis of a US bank. Another standard that translated from the US national to the international context was specification of the Uniform Commercial Code as the means to codify contracts and other transactions. Consonant with this, Motorola and Iridium insisted that the US judicial system be used for any disputes that might arise. Largely these stipulations went unchallenged by non-US investors, partly out of deference to Motorola's founding role but also because these US capacities, not readily replicated in other national contexts, were seen as stabilizing, effective assets in creating a global infrastructure.

But this on-the-ground character of the global, with its prominent US inflection, had a complement: the realization of space infrastructures that completely embraced the planet. Though through the 1980s applications satellites—communications, remote sensing, and weather, both military and civilian—had provided platforms for looking down on Earth, such efforts had a more partial character. They either covered only some fraction of geography (as with communications satellites) or surveyed the entirety of the planet but did so in increments over time (polar-orbiting weather and remote sensing satellites). The 1990s, with privately initiated Iridium and the military-initiated Global Positioning System (GPS) as prime exemplars, saw a seemingly small but significant shift to constellations of satellites that took as their objective near-instantaneous coverage of the entire surface of the planet. Such historical timing was not coincidental, capturing the two complementary aspects of the neoliberal outlook. The market ideal animated Iridium, but the venture's conception and execution was intimately bound to US national security interests. Recognizing the seeming tension between its UN-style organization and close ties to the US military, Iridium offered to create for any nation its own secure military communication space within the network. None took up the offer. In contrast, GPS began as a military tool, but in the neoliberal world became a crucial, global commercial utility as well as a resource for other national militaries. In short, the early to mid–Cold War boundaries between the market and the US military, of the distinctive political-social role of commerce and of the US state, had changed, and a new configuration of relations had been normalized.

Historical (and other humanities) accounts of the 1980s and 1990s give an-

alytic emphasis to flows, circulations, and exchanges across national borders as the critical motifs of globalization. Such analysis has had the virtue of giving globalization a meaning that provides connection and contrast with prior historical eras, a framing that has energized scholarship on the practices and interpretation of European expansion since the fifteenth century. But this work tends to miss this not inconsequential and distinguishing development of the 1980s and 1990s—of making actual, replete globality a reality. But this is a reality, as noted, of a particular kind in which the boundary between markets and nations became fuzzier as did conceptions of military and market relations. In doing so, it changes the way in which we might understand the rubric of flows, circulations, and exchanges in the 1990s, as inseparable from and reconfigured through these new capacities and their embedding in neoliberal market practices.

Though Iridium exemplified these larger period structural political-economic themes, it was, as argued throughout, also a marker of the specific pathways in which historical actors built the 1980s and 1990s global. In this story, three overlapping vectors evident in scholarship captured this making: through the role of corporate engineers and a retheorizing of manufacturing practice; through accommodations between states and corporations, nationally and internationally, primarily in the area of regulation (such as at the FCC and the ITU); and in expressions of ideology in mainstream and business media and in advertising. But two additional vectors, less evident in the literature, proved crucial in the Iridium story and, I would argue, in the larger question of how to understand the 1980s and 1990s: the enhanced interest in culture as a critical category in corporate life and, as a twinned concern, a reconceptualization of the role and place of knowledge. All these vectors, individually and collectively, were given their motive force by preexisting trends in globalization from the 1970s and the concurrent ascendance of neoliberal assumptions. In historiography, the first set of vectors has received scholarly attention, but has not seen them in detail and in conjunction through the lens of the corporation as a critical global actor. Thus, the narrative strategy of this book is to provide a vertical profile of the corporation from the factory floor to high-level politics as well as the topography of its multiple interactions with other actors.

But it is that second set of vectors—of culture and knowledge—that helps capture some of the less noted aspects of the ecology of period globalization. For the historical actors, "culture" as a term and a problem loomed large as a broad organizing trope for a range of issues, perceived as taking on greater saliency in globalization: on the positioning of workers as culture-bearing individuals in a

multinational corporation operating in multiple cultural contexts; in theorizing the corporation itself as a cultural entity; and, as highlighted by Iridium, as a problem in bringing a diversity of elite actors into shared governance of a corporation. As previously noted, this use of culture derived from the confluence of the Japanese manufacturing challenge in the late 1970s and early 1980s with the rise of culture as an explanatory tool in the academy and its dispersion into popular thinking. This perspective took on a significant institutional role at Motorola, as expressed by the creation of Motorola University and its Center for Technology and Culture, as well as the invention of tools such as Six Sigma, which explicitly linked manufacturing quality with employee and organizational culture. Variously, culture as an analytic lens and a solution filtered to various sites in this landscape: in Motorola's Iridium satellite assembly facility as the lubricant to retheorized practices of manufacture; to contractors supporting that work; to Motorola manufacturing facilities around the world in which US multinational corporate culture and the culture of local employees and local governmental authority had to find accommodation.

But culture also was textual strategy, a way of mapping out the meaning of these coexisting, interpenetrating ways of doing and seeing, of the relation of the individual to the corporation, of the latter to a local or regional context. One could see this in the development of *Uncompromising Integrity*, under the aegis of the Center for Technology and Culture, in which culture was the lens to describe, catalog, and interpret the ethical issues that arose for such conjunctions. It was a handbook that sought to move culture and ethics in the multinational context from an ad hoc exercise to a more formalized set of understandings and practices. Culture as a textual question also manifested in the "Iridium Revolution" manuscript, but here the mapping sought to give insight into the ways in which global personal mobile communications, and its situating in various cultural contexts, might give rise to particular trajectories of forward-looking change—at the individual, local, and transnational levels. Through its methods and primary author, the anthropologist Robert Textor, it stood as a direct descendant of the futures studies of the 1950s and 1960s. In each instance, though, these textual investigations of culture took motivation from the assumptions and conditions of period globalization. Such efforts, at least rhetorically, reflected the way in which the individual as an actor became a focus of concern within this larger problematic. For the Motorola principals covered here, such concern came, in part, from neoliberal ideology's foregrounding of the individual as a critical social actor, but also from the company's particular approach to ethics and awareness of historical

inequalities derived from a history of colonial relations. Though such intellectualization did not dominate corporate decision-making, it was a not insignificant element in grappling with the meaning of and response to globalization.

The turn to culture was just one element of a broader rethinking of the kind of knowledge required by the conditions of globalization, as well as its organization within the corporation and its relation to the academy. All were perceived by the historical actors as critical questions. In creating Motorola University, this response is lineally related to early twentieth-century and Cold War initiatives in which corporations sought, under different political economic conditions, to correlate perceived internal knowledge needs with markets and academic sources of expertise. In these prior instances, though, the aim primarily was to create means to bring academic scientific practices into corporate life and translate them into relevant products (commercial or military). Such motivation was nearly nonexistent in the Motorola case and in the larger period trend in establishing corporate universities. Preeminent in concern, rather, was the corporation's placement in the condition of globalization—a reflexive position as a participant, an active shaper, and a reactor to the larger dynamic. From this stance, in the 1980s and 1990s, a new and specific response seemed required, one that elevated in particular "process" as a foundational knowledge problem. As a term of general application, it touched nearly every action and behavior of corporate life, embracing practices within the corporation and in its multiple external contacts and relations. In short, the critical problem of knowledge in globalization was the corporation itself. This provided the core rationale for embedding the university in the corporation.

This insight linked the corporate university back to the heightened value placed on understanding and living in a culture-infused world. Motorola University did not simply seek to make its "students" more knowledgeable in specific corporate relevant subjects, but to create a particular kind of corporate citizen. Process as idea and practice was the critical ground on which this happened. It joined together expertise, culture, and the idea of the individual as a critical agent in the success of the organization. Six Sigma methodology embodied this approach as did the less ideologically driven focus on lean manufacturing. It is easy, of course, to see in the corporate context the limits to such claims about enhanced individual agency. How did they actually play out in the day-to-day experience in the multiple places in which the corporation operated? But the emergence of the corporate university and of specific methodologies such as Six Sigma were more than glosses to corporate life. The resources devoted to them stand as one marker.

At a deeper level, they were fundamental indicators of the degree to which globalization as a condition and a problem stimulated rethinking about a range of categories, of what features of the world needed intellectual attention (such as culture), and of the status of the individual in corporate life.

For a technology-driven entity such as Motorola, efforts to relate scientific sources of knowledge to technical practice did not become irrelevant, of course, but corporate leadership realized that the broad scope of process-inflected knowledge had become an equal determinant of market success. As such, they perceived a need, in quasi-academic fashion, to make it a domain of investigation. But in contrast to early episodes of corporate knowledge-fashioning, relations to the academy had lesser relevance; the domain of concern did not map directly onto disciplinary expertise. Hence the move, rhetorically and practically, to internalize the "university" into the corporation, a means to define the boundaries of its effort and the critical problems therein—and then find common cause as appropriate with academia. The corporate university phenomenon remains to be properly studied and put alongside the contemporaneous development of universities refiguring their knowledge relations in making the market turn.

All of these points raise a final historiographic issue: how to characterize the end of the Cold War. In this instance, and more broadly I would argue, changes well under way in the 1980s stood as the primary shapers of the 1990s. Neoliberal ideology and corporate reinvention provided the foundation. But the end of the Cold War gave radical amplification to globalization as actual *total* globality. There was a synergy between the opening of Russia and its former client states to Western markets and the move to create global infrastructures such as Iridium. The latter was not possible without the former. The end of the Cold War, too, gave a rationale to expand US and European corporate activity in China. Expanding the geographic range of markets was paired with and made plausible space-based enclosure of the globe. This dynamic touched not just former adversaries, but also repositioned the developing world as part of this fluid global geography. As outlined above, this conceptual outlook, although viewed in different ways by different actors, had enough shared purchase to make Iridium possible—to give it the strong, affirmative symbolism it conveyed in and of the 1990s.

But it was not merely these political reorientations alone that spoke to the post–Cold War 1990s condition. The deeper emotional and utopic core of the effort centered on the narrative relation among individual mobile communications technology, neoliberal markets, and the idea of a completely open geographic Earth-scape. Iridium's space-based infrastructure gave ideological emphasis to

this triumvirate—of the autonomous individual through mobility fashioning an identity, to reposition oneself literally so as adjust one's relation to community, nation, and globe, to not be confined by borders, to be presumptively a neoliberal agent working within or against one's immediate political or cultural circumstances. The enterprise, as with much of the period's enthusiasm for all communications innovations, entered into the longer history of colonial and postcolonialism, to see this new capability as a rectifying tool for rebalancing, albeit imperfectly, longstanding disparities of power. It was to envision the individual as a spatial actor, in and out of place, in and out of a particular cultural existence, as rooted in a non-Western tradition and emerging as a universal Enlightenment citizen, a beneficial result of a market world. Though such notions were imbued with fancy, they were inseparable from the tangle of political and business relations expressive of the 1980s and 1990s.

Notes

Introduction

1. Useful overviews of the multinational corporation, historically and in relation to globalization as presented here, are Chandler and Mazlish, *Leviathans*, and Mazlish, *The New Global History*.

2. This point regarding recent globalization as *literal* globalization through the merger of space-based technological infrastructure and neoliberal capitalism is muted in the literature. A form of the literally global, though, is prominent in the environmental literature, especially in the recent Anthropocene literature, in which the planet as a physical system and modernist economic activities and impacts are brought into the same analytic frame. The now-classic statement of this is Steffen, Crutzen, and McNeill, "The Anthropocene."

3. As a matter of terminology, I use roughly interchangeably "First World," "Second World," "Third World," and "developing" / "developed" as descriptors of political and economic positioning in the 1980s and 1990s for two reasons. Such framing reflects period actors' own usage and captures the conceptual uncertainty by the actors and academics of how to characterize these boundaries in the condition of the neoliberal global.

4. On the dispersal point, see Maier, *Among Empires*. This is the key point in his argument for identifying the transition of the US political economy circa 1980 from an "empire of production" to an "empire of consumption." The motif of "death of distance (and time)" gained a popular foothold through Cairncross, *The Death of Distance*.

5. As one indicator of this claim, see Yúdice, *The Expediency of Culture*. The book's argument focuses on the use of culture by elites to achieve self-serving ends. This applies to Motorola and Iridium, in part. But Yúdice's thesis misses how the invocation of culture also reflected the confusion and uncertainties attached to the heightened level of transnational exchange that attended the post-1980 era of globalization and to comprehend and respond to such exchange, especially in the context of markets.

CHAPTER ONE: **Iridium and the Golden Age**

1. Motorola and Iridium couched this claim as "nearly" global coverage. The signal could not penetrate buildings. Structures in dense urban areas and canopies of trees might shade, obstruct, or diminish satellite signals.

2. Bennahum, "The United Nations of Iridium." The investors, by 1998, in addition to Motorola, included Bakrie Group of Companies (Indonesia); Saudi Binladin Group (an entity that gained notoriety after September 2001 through its familial connection to Osama bin Laden) (Saudi Arabia); Vebacom (Germany); Inepar S.A. (Brazil); BCE Mobile Communications (Canada); Ilapeca (Venezuela); Kyocera Corporation (Japan); Industrial

Development Bank of India (India); Krunichev State Research and Production Center (Russia); SK Telecom (Korea); Telecom Italia (Italy); Sprint (United States); Lockheed Martin (United States); Raytheon (United States); UCOM (Thailand); Pacific Electric Wire & Cable Company (Taiwan); and China Aerospace International Holdings (China).

3. As the design of the system evolved over the next few years, the number of satellites in the constellation was reduced to 66—the atomic number of the element dysprosium.

4. As costs and regulatory complications arose, all but one of these other efforts gradually folded their tents over the 1990s. The one remaining competitor was Globalstar, backed by Loral, an aerospace industry stalwart. Globalstar succeeded in financing and building its system, but always trailing along behind Iridium's vanguard. Globalstar, like Iridium, went through bankruptcy before achieving some measure of stability.

5. These events in China are related in Mark Gercenstein, Oral History Interview, Iridium Oral History Project, NASM. Gercenstein was Iridium's representative in China at the time of the press announcement. He noted that "the reasons for being in Beijing were twofold. One was that we knew this was going to be a global system, so we knew we needed to have Russia and China. If you just look at the land mass of the Soviet Union at that time and China, we needed to have those. We were looking for a way to start penetrating China. The second reason was that Motorola was just starting to get real big in China. These two reasons were to complement each other."

6. One of the signature post–Berlin Wall expressions of this outlook was Fukuyama, "The End of History?" His views were developed further in Fukuyama, *The End of History*.

7. For overviews, see Harvey, *A Brief History of Neoliberalism*, and Antonio, "The Cultural Construction of Neoliberal Globalization." For a short synopsis of neoliberalism and its relation to earlier ideologies of the market, see Treanor, "Neoliberalism."

8. For a critical view of this development, see Frank, *One Market under God*. One of the prominent examples of journalism that sought to describe and assess these developments, but yielded to the enthusiastic tenor of the time, was the work of the *New York Times* op-ed columnist Thomas Friedman, with his *The Lexus and the Olive Tree* as a prime example.

9. On the Washington Consensus, see the detailed discussion in chapter 3. On the New Economy, see DeLong and Summers, "The New Economy."

10. For insight into such issues in the areas of aviation and space, see Krolikowski, "China and the United States."

11. On various elements of this constellation of changes, regarding satellites, see Parks, *Cultures in Orbit*; regarding mobile telephony, see Galambos and Abrahamson, *Anytime, Anywhere*, as well as Castells, *Mobile Communications and Society*; and regarding undersea fiber-optic cables, see Starosielski, *The Undersea Network*.

12. A useful overview of literature on the idea of an information society, the multiple meanings attached to the concept of communications, and their relation to capitalism and postmodernism is Webster, *Theories of the Information Society*. For an exploration of the cultural dimensions of the new modes of communication, see Streeter, *The Net Effect*.

13. Habermas, *The Structural Transformation of the Public Sphere*. This is a translation of Habermas's work, originally published in 1964, well before the notion of an information revolution had gained broad currency.

14. On China in the 1990s, see Shah and Wasserstrom, *Chinese Characters*, and Benewick and Wingrove, *China in the 1990s*.

15. Krolikowski, "China and the United States."

16. For insight on these points, see Durrell Hillis, Oral History Interview, Iridium Oral History Project, NASM, and Thomas Tuttle, Oral History Interview, Iridium Oral History Project, NASM.

17. Thomas Hughes's work on systems seems more useful as a description than as a methodology for elucidating the broad implications of big technology. Over the course of his work, he has given decreasing attention to the political dimensions and ramifications of systems; his emphasis has been primarily on the inventor-engineer as problem solver. This methodological emphasis seems inadequate to comprehend Cold War and now market big technology initiatives, but many scholars have used Hughes's ideas to greater effect. On Hughes's characterization of systems, see T. Hughes, *American Genesis*. For work in the Hughesian vein, see A. Hughes and T. Hughes, *Systems, Experts, and Computers*, and T. Hughes, Mayntz, and the Max-Planck-Institut für Gesellschaftsforschung, *The Development of Large Technological Systems*.

18. See, for example, Chandler, *The Visible Hand*; Balogh, "Reorganizing the Organizational Synthesis"; Brinkley, "The New Deal and the Idea of the State"; Hart, *Forged Consensus*; Yergin, *Shattered Peace*; Galbraith, *The New Industrial State*; Leslie, *The Cold War and American Science*; and Collins, *Cold War Laboratory*. On the broad geopolitical and economic similarities and differences between the early and late Cold War, see Leffler and Westad, *The Cambridge History of the Cold War*, vol. III.

19. Perhaps the foremost instance of seeking to understand how US power correlated with such conceptual categories is Maier, *Among Empires*. For an affirmative "exceptionalist" view of US power on the international stage, see Ferguson, *Colossus*.

20. As one example, such tension is apparent in Giddens and Hutton, "Anthony Giddens and Will Hutton in Conversation."

21. On post-industrialism, see D. Bell, *The Coming of Post-Industrial Society*. This edition has a useful foreword by Bell reflecting on the reception and use of his idea since the book's original publication in 1973. For Galbraith on the corporation and US society, see *The New Industrial State*. Several classic references that shaped discussion on postmodernism and its relation to capitalism and technology are Jameson, *Postmodernism* (Jameson's seminal essay, from which the book takes its title, was originally published in 1984); Giddens, *The Consequences of Modernity*; and Harvey, *The Condition of Postmodernity*. The best synoptic treatment of the claim of a post-1970s reconfigured capitalism and its impact on business is Boltanski and Chiapello, *The New Spirit of Capitalism*.

22. See Lyotard, *The Postmodern Condition*, and Jameson, *Postmodernism*. In addition to the works of Giddens and Hughes, also helpful in comprehending the modernist-postmodernist tangle are Forman, "Recent Science," and several works by Bauman, including *The Individualized Society*. A useful essay on questions of periodization is Douglas, "Periodizing the American Century."

23. Tensions between the local and the global, the particular and the universal, ethnos and transcendental humanity have received much attention. This is addressed, optimistically, in Friedman, *The Lexus and the Olive Tree*. Two accounts written in the time period relevant to this study from different political perspectives on the counter-universalism thesis are Barber, *Jihad vs. McWorld*, and Huntington, *The Clash of Civilizations*. An important conceptual essay on these issues is Hollinger, "How Wide the Circle of the 'We'?" For

insight into the interconnections between electronic media and transnational communities, see Appadurai, *Modernity at Large*.

24. The specific ways in which a global political and market order has been created is the subject of an increasing literature. See, for example, Sassen, *Globalization and Its Discontents*, as well as idem, *Territory, Authority, Rights*. See also Castells and Hall, *Technopoles of the World*. This issue involves not only participation in the market but also actively creating political and policy frameworks that support corporate action and technology development. For the broad view, see Yergin and Stanislaw, *The Commanding Heights*. For the oft-referenced theoretical statement of the connections among technology, legal, and political regimes, see Scott, *Seeing Like a State*.

25. See chapter 4 for Gore's participation in Iridium's rollout in the fall of 1998. More broadly, the project received favorable reception at the FCC, the State Department, and the Commerce Department, as well as the DoD.

26. Numerous business school case studies have been done on Iridium; for example, see MacCormack and Herman, "Rise and Fall of Iridium."

27. This transition to new ownership is the focus of a detailed journalistic account; see Bloom, *Eccentric Orbits*.

28. On the importance of the contract as a defining element of the Cold War state, see Nieberg, *In the Name of Science*. On the notion of distinct spheres (government, academia, business) in the American polity and their importance in shaping Cold War culture, see Friedberg, "Why Didn't the United States Become a Garrison State?" A relevant variant of such analysis is often dubbed "corporatism," and an important application in interpreting the early Cold War is Hogan, *A Cross of Iron*.

29. On various aspects of knowledge production and relations among the state, industry, and academia, see, as a selection, Leslie, *The Cold War and American Science*, and Noble, *Forces of Production*.

30. A detailed descriptive treatment of the concept of "project" in the Cold War is Johnson, *The Secret of Apollo*. For the challenges of understanding the varied imports of the market in relation to knowledge production and the change in this relationship through time, see Mirowski, *Science-Mart*.

31. The business literature on start-ups is vast. One example that captures the relationship between start-ups and the neoliberal moment is Case, *The Third Wave*. It is a homage to Toffler's seminal 1980 publication of the same title.

32. Gercenstein, Oral History Interview.

33. This was starting presumption of the Motorola engineers. See especially Hillis, Oral History Interview, and Bary Bertiger, Oral History Interview, Iridium Oral History Project, NASM. This development of project management knowledge—the transition from an elementary set of to-be-learned practices localized to those participating in initiatives such as the ballistic missile program to a resource for many engineers and managers—is an underappreciated social engineering accomplishment of the Cold War state.

34. On the origins and development of the deregulation and markets-over-governments movement, see Yergin and Stanislaw, *The Commanding Heights*.

35. For an analytic discussion of definitions and characteristics of culture, see Williams, *Sociology of Culture*. On culture as a key vector in the post-1980 context, see Yúdice, *The Expediency of Culture*.

36. A useful overview of these developments is Waring, *Taylorism Transformed*.

37. The literature relating to the global is vast. Sociology, political science, economics, and theories of the postmodern have approached the concept of globalization from different perspectives, each trying to account for or problematize a set of interrelated changes: a shift in the meaning and uses of space and time in day-to-day life; increased possibilities for social interconnectedness across traditional geographic or political boundaries; and the speed, frequency, and consequences of such interconnections for cultures, communities, and individuals. Technology, corporations, the behavior of capitalistic markets, and government policy provide, variously, descriptive or causal frameworks for these changes. A useful analytic treatment is Albrow, *The Global Age*. As a compendium assessment, see Ritzer, *The Blackwell Companion to Globalization*; for a précis of the literature and issues, see Osterhammel and Petersson, *Globalization*. From a transnational history perspective, see Iriye, *Global Interdependence*. For a concise analysis of the global across disciplines, see Middell and Naumann, "Global History and the Spatial Turn." For an important critique of the globalization literature, especially as regards its historical distinctiveness, see Lang, "Globalization and Its History."

38. Jameson, *Postmodernism*, 20.

39. As the space age developed, the deployment of satellite systems for monitoring or communicating around the Earth had been approaching such a state. The Global Positioning System (GPS) constellation in 1995 was the first to accomplish this feat; Iridium followed in 1998. The Russian GLONASS system also was completed in 1995, but went into decline shortly thereafter as a consequence of Russia's economic troubles and was not fully restored until 2011. In the civilian (nonmilitary government) and commercial sectors, communications and meteorological and other remote sensing systems provided either near global coverage or global coverage on a periodic (non-constant) basis. The same probably is true of military and intelligence satellite systems.

40. This optimistic-leaning view could be contrasted with Marshall McLuhan's 1960s concept of the "global village," partly inspired by the early accomplishments in satellite communications and spaceflight, but more by the spread of pre–space age print, radio, and television communications. For McLuhan, the political meanings of the global were more ambiguous and did not necessarily reinforce liberal democratic values—indeed, they might promote "tribal" rather than modern conceptions of polity. See McLuhan, *Explorations in Communication*.

41. R. S. Moorthy and Robert B. Textor, "The Iridium Revolution: Anticipating the Human Impacts and Sociocultural Implications of Global Personal Connectivity," Ray Leopold Oral History Working File, Iridium Oral History Project, NASM.

42. The quote is from ibid., 115.

43. Or more precisely, Iridium's rhetoric included the populist but its business plan aimed for the "cream" of the market. From the beginning, estimates for phone prices ranged from $2,000 to $3,000 and per minute charges around $3—both above cellular standards of the early to mid-1990s—but the base $3 per minute charge was consistent with international call charges in the mid-1990s.

44. On the clear connection between system design and perceptions of global business practice, see Hillis, Oral History Interview. Hillis was a pivotal figure in Iridium. As the project was initiated, he was a key manager in Motorola's defense unit and was the

person most responsible for shepherding the idea from embryonic stage to support by Motorola management. He then served as the head of the project and was instrumental in shaping the project's engineering and organizational culture.

CHAPTER TWO: **The Global and the Engineers**

1. For an overview of DoD budget trends and research and development expenditures in the 1980s and after, see US General Accounting Office, *Defense Industry*. In the 1980s, the peak year for DoD spending through contract was 1985.

2. Characterizations of the meeting were provided by several participants. See Oral History Interviews with Durrell Hillis, Bary Bertiger, and Raymond Leopold, Iridium Oral History Project, NASM. On 1989 as historical watershed, see Kumar, *1989*.

3. On the latter, the iconic author identifying a revolutionary shift in political economy and culture at the verge of the 1980s is Alvin Toffler. See Toffler, *The Third Wave*, as well as the corporation-focused *The Adaptive Corporation*.

4. On this point, see especially the Oral History Interviews with Bertiger and Hillis.

5. Andrew Feller, "The Iridium satellite production system," undated, Andrew Feller OHI Working File, NASM. Though not dated, based on its content the document is probably from 1997.

6. Mark Gercenstein, Oral History Interview, Iridium Oral History Project, NASM.

7. These points regarding idealism in the venture come from several Oral History Interviews, especially Hillis, Leopold, John McBride, and Andrew Feller. The quotes are in Andrew Feller, Oral History Interview, Iridium Oral History Project, NASM.

8. Leverage through technical expertise was one part of the dynamic. The other was leverage through Motorola's financial investment in its own company. These dynamics changed with time as Motorola's financial position changed (from full control to a less than 20 percent share) and Iridium had to assert its independence to represent the interests of all its investors. This change began to play out in 1994–1995 and continued through bankruptcy.

9. Russian and Chinese launch personnel were not "in" this community. The critical issue was that Motorola and its contractor personnel be able to structure their work at these respective launch sites to Motorola-defined processes and behaviors. These issues were worked out in negotiations as part of the launch contracts. See Ted Kehl, Oral History Interview; McBride; Oral History Interview; and Dannie Stamp, Oral History Interview, Iridium Oral History Project, NASM.

10. The importance of process as a strategy in period business thinking is developed in Pisano, *The Development Factory*.

11. For a review of the quality literature and its relation to the Baldridge Award, see Winn and Cameron, "Organizational Quality."

12. See McBride, Oral History Interview, as well as Feller, Oral History Interview.

13. The seminal and most influential text for Motorola and others was Womack et al., *The Machine That Changed the World*. For an account of the application of lean production outside Japan, see Delbridge, *Life on the Line in Contemporary Manufacturing*. For a focus on the United States, see Liker, *Becoming Lean*. Embedded in these texts was the assumption of a new, distinct era of industrialization. Published in 1984, Piore and Sabel's *The Second Industrial Divide* makes this case explicitly. Interestingly, though the zeitgeist was

obsessed with "change," especially as related to the consequences of new information technologies, the problem of information *in* the corporation received comparatively less attention, but this did become a focus as the 1990s progressed; see Allen and Scott Morton, *Information Technology and the Corporation of the 1990s*.

14. Indicative of the business enthusiasm for Six Sigma and of Motorola's prominent association with the method from the 1980s through the 1990s is Pande, Neuman, and Cavanagh, *The Six Sigma Way*. See also Pande, Neuman, and Cavanagh, *The Six Sigma Way Team Fieldbook*.

15. On these points, see William Wiggenhorn, Oral History Interview, Iridium Oral History Project, NASM. Wiggenhorn headed up Motorola's training organization in the 1980s and in the 1990s served as president of Motorola University.

16. For a useful historical overview of the assembly line as a conceptual and cultural marker, including some review of the 1980s, see Nye, *America's Assembly Line*.

17. Under the best of circumstances, Motorola probably would not have provided corporate records to the author. But given that Iridium went into bankruptcy and that Motorola immediately was embroiled in investor lawsuits put all Motorola records relating to Iridium in purgatory.

18. Kenneth Peterson, Oral History Interview, Iridium Oral History Project, NASM.

19. In 1998, *Aviation Week and Space Technology*, the preeminent trade publication for the aerospace community, awarded the three its Laureates Award in recognition of their role as inventors of Iridium.

20. A technical overview of the system is Nelson, "Iridium."

21. A series of investor research reports provides a detailed overview of Motorola's organization and activities over the 1980s and 1990s. See Beattie and O'Brien, *Inside Motorola*.

22. The following account is drawn from Oral History Interviews with Peterson, Bertiger, Leopold, and Hillis.

23. Though the critical importance of "systems" in Cold War intellectual thought has been noted, the significance of its allied concept of the "project" as a means for implementing systems has not received assessment for its historical import as a socioeconomic methodology. A proximate but narrower look at this issue is Johnson, *The Secret of Apollo*. On the project as a conceptual and organizational category in business history, see Scranton, "Projects as a Focus for Historical Analysis."

24. These points regarding the politics of primes and the ambition of Motorola's government unit to become a prime are in several Oral History Interviews, including Bertiger.

25. The 1960s saw a spate of professional and textbook publications on project management, developed as recognition of the broad impact of defense contracting on national economic life and to suggest the wider relevance of this methodology to nondefense enterprises. Representative of this literature is Hajek, *Project Engineering*. The "profitable" in the book's subtitle (*Profitable Technical Program Management*) is referencing the applicability of defense project methods to the larger market.

26. On the broad context of this development, see Light, *From Warfare to Welfare*. For the specific instance in the 1970s of "turning" defense firms into producers of a standard light rail car for use in multiple cities, see Weiner, *Urban Transportation Planning in the United States*.

27. Bertiger, Oral History Interview.

28. The starkness of this divide is captured by Hillis: "Frankly, Motorola's goals, with regard to this [government contract work], in 1986–1987, were nonexistent, because this business was a small piece of the corporation, frankly, a piece of the corporation that the leaders of the company didn't understand and didn't worry about it. It was sort of like, 'Okay, go play in your government sandbox. As long as you're making money, I don't want to know about it.' Not literally, but sort of to characterize how that was." Hillis, Oral History Interview.

29. This account derives solely from Bertiger and its accuracy and import rely on future access to corporate records.

30. Lyotard, *The Postmodern Condition*.

31. A useful and representative account is Mirowski, *Science-Mart*.

32. The best review of this trend is Cunningham et al., *The Business of Borderless Education*. Additional insight into the scale and motivations of this development is Allen, *The Corporate University Handbook*, and Meister, *Corporate Universities*.

33. Wiggenhorn, Oral History Interview.

34. See Wiggenhorn, "Motorola U."

35. Wiggenhorn, Oral History Interview.

36. Ibid.

37. Ibid.

38. Ibid.

39. Ibid.

40. Ibid.

41. These various points are from ibid.

42. History of the Department of Energy and Clinton Administration History Project, "[Energy]," *Clinton Digital Library*, accessed August 30, 2017, https://clinton.presidentiallibraries.us/items/show/4625.

43. Wiggenhorn, Oral History Interview.

44. Peterson, Oral History Interview.

45. Ibid.

46. Hillis has provided his own account of the Iridium story, going into greater depth especially on the engineering aspects of the venture. See Hillis, *Creating Iridium*.

47. The early conceptualization of the engineering possibilities is covered in greatest detail in Leopold, Oral History Interview.

48. Indeed, ironically, cellular phone service in Chandler, where the engineers worked, was spotty to nonexistent.

49. On this decision, see Gercenstein, Oral History Interview.

50. Leopold, Oral History Interview.

51. This was an obvious consideration for potential investors and by Securities and Exchange Commission (SEC) regulation a requirement to solicit investment. But it also was a criterion for the Federal Communications Commission (FCC) in granting spectrum to any proposer. Spectrum was an exceedingly valuable economic asset and thus the FCC decision-making made business viability a key criterion in its review process.

52. Quote from FCC filing.

53. The first of these studies, cursory in its analysis, was conducted in 1990–1991 and

was incorporated into a "Private Placement Memorandum," 1991, Iridium Papers, NASM. This document was the first comprehensive description of Iridium's business plan and technology and was used to begin the process of courting potential investors.

54. Link margin was dependent on two factors: the power of the signal generated from the satellite and the efficiency of a ground antenna in receiving the signal. The critical variable was the strength of the signal generated by the satellite.

55. On the clear connection between system design and perceptions of global business practice, see Hillis, Oral History Interview. Hillis was a pivotal figure in Iridium. As the project was initiated, he was a key manager in Motorola's defense unit and was the person most responsible for shepherding the idea from embryonic stage to support by Motorola management. He then served as head of the project and was instrumental in shaping the project's engineering and organizational culture.

56. Ibid.

57. Ibid.

58. D. S. Howard & Associates, "Project 1445," September 1994, unfoldered, Box 3, Iridium Papers, NASM.

59. As Hillis recalled: "And in order to determine what link margin is required to get inside the car, we hired some propagation expert from the University of Texas in Austin to collect data. And what he did was put automobiles, vans, pickups, different kinds of vehicles, on a carousel, and had a signal source at different angles of elevation to that vehicle. And then you would transmit a signal, and you'd measure it inside the car at various parts, various points, to determine what's the path loss that's occurring, getting into that car." Hillis, Oral History Interview. This example touches on a broader point on the use of simulations to support decisions regarding engineering parameters and design.

60. For an overview of the ACTS program, see https://www.nasa.gov/centers/glenn/about/fs13grc.html.

61. Concurrently, the military began to develop switching technology for use in its MILSTAR satellites that began deployment in the late 1980s.

62. See Forest, "An Analysis of Military Use of Commercial Satellite Communications."

63. Interestingly, in the 1970s when pursuing a master's degree at Claremont Graduate University, Stamp did coursework with Peter Drucker.

64. On these points, see Hillis, Oral History Interview; Stamp, Oral History Interview; David Montanaro, Oral History Interview, Iridium Oral History Project, NASM; and Feller, Oral History Interview.

65. Montanaro left Motorola in 1995, in part, over frustrations at the limitations of his role, but also to join Teledesic, the next big space communications venture then taking shape. Montanaro, Oral History Interview.

66. Stamp, Oral History Interview.

67. Hillis, Oral History Interview.

68. Ibid.

69. Ibid.

70. Ibid.

71. Ibid.

72. Leopold, Oral History Interview.

73. See "Space System CDR," December 1994, unfoldered, Box 3, Iridium Papers, NASM.

74. Hillis, Oral History Interview.

75. Ibid.

76. Ibid.

77. Ibid.

78. Several of the interviews speak to this point, but see especially Hillis, Oral History Interview, and Leopold, Oral History Interview.

79. See Leopold, Oral History Interview. In 1996, Leopold moved from the Iridium engineering group to head the next-generation effort.

80. The name Six Sigma came from an aspiration at Motorola to reduce the number of defective products to the statistical equivalent of six sigma, that is, roughly one in a million. Six Sigma as a method entwined two aspirations. One emphasized the use of mathematical tools to measure and assess manufacturing processes. The other focused on a conceptual approach to analyzing and revamping processes to improve performance, which was the emphasis in "lean manufacture." The latter view of the method was dominant in Iridium.

81. Over the 1990s, Six Sigma spread to other large firms such as General Electric and became the preferred tool for corporate cultural reinvention, spawning a substantial "how-to" literature. The bible is Pande, Newman, and Cavanaugh, *The Six Sigma Way.* See also idem, *The Six Sigma Way Team Fieldbook*. For a short, nuanced account of the method's origins at Motorola and its role in corporate life, see Ramias, "The Mists of Six Sigma."

82. This was the core message of Peters and Waterman, *In Search of Excellence*.

83. These points are covered in McBride, Oral History Interview.

84. It is important to distinguish Hughes's original notion of "system" from the Cold War concepts of "project" and "integration." While there are important similarities, there is a key difference. "System" as developed in Hughes's seminal work *Networks of Power* was an accretive process—an effort extending over time in which the articulation and build-up of a technological complex was contingent on advocates securing markets and, as needed, political accommodations. As a product of entrepreneurship, markets, and capitalism, "system" started from the bottom and worked up; its end point was never predetermined or foreordained. In World War II and the Cold War, this formula largely was reversed. The large-scale system, in concept, existed from the start. The political authority and funding capability of the state enabled the translation of the concept into something concrete—first as an active project organizational structure, a system of contracts, and perhaps eventually a technological complex. The material and political dynamics of the project and integration thus are fundamentally different from Hughes's original concept of system. Hughes himself seems not to have highlighted this difference. In his work on Cold War subjects, system is approached in the same way as pre–World War II examples. On the early Hughes, see T. Hughes, *Networks of Power*; for treatment of Cold War systems, see A. Hughes and T. Hughes, *Systems, Experts, and Computers*.

85. Peterson, Oral History Interview.

86. An early and enduring example of this framing of corporate life around values, culture, and an enhanced status for the individual (at least rhetorically) was Peters and Waterman, *In Search of Excellence*. Importantly, this book, which had wide influence in

the US business community, situated its argument historically, as particularly expressive of the conditions of the late 1970s and early 1980s, as the challenge from Japan and neoliberal policies were reorienting global business practice. As stated early in the book (26), "it appears the real role of the chief executive is to manage the values of the organization," a statement regarding the elevated place of culture as an explicit category in corporate life. A similar framing also is the departure point for Kunda, *Engineering Culture*, in which the 1980s high-tech corporate world and culture are brought into the same analytic frame but with the narrower focus on practices within a single organization. Though helpful in demonstrating the rise in attention to culture by corporations and by engineering as a profession, Kunda's work leaves unaddressed the broader template of issues in which the turn to culture was embedded. In the same but more popular vein, see Kidder, *The Soul of a Machine*. On a more theoretical level, see McKinlay and Taylor, *Foucault, Governmentality, and Organization*. More recently there has been a move to train engineers as part of college curricula to understand their professional role through a global-cultural lens. See Downey, *Engineering Cultures*.

87. Peterson, Oral History Interview.

88. McBride, Oral History Interview.

89. Ibid.

90. This point is further considered in chapter 4.

91. Feller, "The Iridium Satellite Production System."

92. Hillis, Oral History Interview.

93. Peterson, Oral History Interview.

94. Other interviewees did not see this transition as starkly as Peterson did.

95. A useful overview of the various quality methods, such as Total Quality Management (TQM), that emerged in this period is Waring, *Taylorism Transformed*. For a critique of this movement, see Jackson, *Management Gurus and Management Fashion*.

96. For a comic, often polemical, and sometimes accurate account of the relation between academic cultural studies and business uses of culture, see Frank, *One Market under God*, chapter 8. Also, on the broad purchase of "culture" in the 1980s and 1990s, see Yúdice, *The Expediency of Culture*.

CHAPTER THREE: **The Global and Iridium the Business**

1. See "Fact Sheet: The President's National Security Telecommunications Advisory Committee," https://www.dhs.gov/publication/nstac-fact-sheet.

2. "Bill Clinton on America's Space Program," unfoldered, Box 6, Iridium Papers, NASM.

3. On Clinton and the culture wars of the 1990s, see Hartman, *A War for the Soul of America*.

4. For a general overview of state-centric control and the move to liberalization, see Huurdeman, *The Worldwide History of Telecommunications*, especially chapter 33. Though such change often was called deregulation, it was really a different regime of regulation in which markets were opened up to other firms beyond a monopoly supplier.

5. There is no scholarly history of the ITU; for a broad sense of the organization and its change through time, see its anniversary publication, *International Telecommunication Union*. For parts of the ITU story, see Slotten, "The International Telecommunications

Union," and idem, "International Governance," as well as Schwoch, *Global TV*. On the Telecommunications Act of 1996, see Economides, New York University, and the Center for Law and Business, *The Telecommunications Act of 1996*.

6. Literature on the recent history of the International Telecommunications Satellite Organization (Intelsat) and the International Maritime Satellite Organization (Inmarsat) is thin. For a review of recent change through a policy lens, see McCormick and Mechanick, *The Transformation of Intergovernmental Satellite Organisations*. On Intelsat's early history, see Slotten, "Satellite Communications, Globalization, and the Cold War."

7. Williamson, "What Washington Means by Policy Reform." Williamson reflected on this article and the Washington Consensus in a reassessment of World Bank development policy in the 1990s; see "The Washington Consensus." For a critique of the neoliberal orientation of the Washington Consensus by a fellow policy elite, see Stiglitz, "More Instruments and Broader Goals," as well as idem, *Globalization and Its Discontents*.

8. Through the 1990s and early 2000s, the "Washington Consensus" as a phrase and as a description of a set of policy prescriptions became a flashpoint of contention among economists and policymakers, primarily dividing them over the value of neoliberal positions as a means for improving the political economic lot of developing countries. The potency of the "Washington Consensus" as an issue derived from the ideological stakes but more because this framework was adopted as a template for development by the World Bank, the International Monetary Fund (IMF), and the US Treasury Department. For one assessment of these issues, see Kuczynski Godard and Williamson, *After the Washington Consensus.*

9. Frieden, *Global Capitalism*. For an analysis of the 1990s as a distinct economic formation, see Frankel and Orszag, *American Economic Policy in the 1990s.* For an argument that the 1980s and 1990s witnessed a diffusion of power, including to criminal enterprises, see Strange, *The Retreat of the State*. Oddly, in the same time frame as these events, the business guru Peter Drucker was seeing the emergence of a post-capitalistic society, a formation in which knowledge as a critical resource rather than capital would structure economic life. See Drucker, *Post-Capitalist Society*.

10. The broad contours of Motorola's corporate activities in the 1980s and 1990s are covered in Steinbock, *Wireless Horizon*. For a short background history of decisions that enabled the award, see Bhote, "Motorola's Long March."

11. On these various points, see Roni Haggart, Oral History Interview, Iridium Oral History Project, NASM.

12. In the United States, these functions were split between the US Post Office and the AT&T Corporation. Reflective of the discussion here, AT&T's monopoly was undone legally in 1982 as part of the broader trend toward regarding markets as the political-economic ideal. See Temin, *The Fall of the Bell System*.

13. For an overview of these period developments, see Cronin, *Global Rules*.

14. The only key personnel change through the 1990s occurred at the end of 1996, when Adams was forced out in favor of Edward Staiano, who had served as the head of Motorola's cellular products division, a multibillion-dollar slice of the company. Rothblatt's consultant's role lasted about a year.

15. On this process, see US Congress, Office of Technology Assessment, *The 1992 World Administrative Radio Conference*, as well as Walda Roseman, Oral History Interview, Iridium Oral History Project, NASM.

16. Of course, such governmental support of US corporations had a long history, with state-market relations defined by a particular era's political economic orientation. As a sampling, see Rosenberg, *Spreading the American Dream*, and Maier, *Among Empires*.

17. The documentary record is unclear as to whether the June 1990 rollout was purposely intended to attract the support of US regulators, in addition to laying the groundwork for private investor support.

18. Robert Kinzie, Oral History Interview, Iridium Oral History Project, NASM.

19. Martine Rothblatt, Oral History Interview, Iridium Oral History Project, NASM.

20. Of course, this is a long-running theme in US foreign relations; only the context and modes of collaboration have differed.

21. Thomas Tuttle, Oral History Interview, Iridium Oral History Project, NASM.

22. Ibid.

23. Ibid.

24. "China: Possible Missile Technology Transfers from U.S. Satellite Export Policy—Actions and Chronology," Congressional Research Service Report, March 2003, 98–45 F. Although Iridium escaped blame, other companies did not.

25. Much of this conspiratorial material still is available on the Web. See "Ron Brown's Secret Files" (2000), http://www.wnd.com/2000/09/7120/.

26. On these points, see Roseman, Oral History Interview.

27. US Congress, Office of Technology Assessment, *The 1992 World Administrative Radio Conference*, 12–13.

28. Ibid.

29. Ibid., 12. The Industry Advisory Committee was a critical part of the Federal Communications Commission's (FCC) planning approach, consistent with the turn to the market; from the report: "the FCC created an Industry Advisory Committee (IAC) in January 1990 to provide direct private sector input to the Commission on WARC matters. The IAC actually played a dual role in the FCC's WARC preparation process. It was a commenter on the NOIs and it developed some of the proposals later included in the FCC's final Report" (81). NOIs were Notices of Inquiry, a formal commitment by the FCC to examine proposals (usually from industry) to examine the merits of a new service or an allocation of spectrum.

30. Ibid., 63.

31. Ibid.

32. Ibid.

33. "Private Placement Memorandum," September 1991, Box 11, Iridium Papers, NASM. Hereafter referred to as PPM.

34. Both William English and Thomas Tuttle had been involved in the Satellite Business Systems, a joint venture of IBM, Aetna, and Comsat, and brought that experience to Iridium. See Tuttle, Oral History Interview.

35. See folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

36. Ibid.

37. A cross-section of these studies can be found in Box 4, Iridium Papers, NASM. See also a summary statement in "Iridium: $650,000 Senior Secured Credit Facility, $750,000 Senior Guaranteed Credit Facility," November 1998, 3–10. This document provided the background and terms of Iridium's last major loan arrangement, part of the basis

for which rested on bank-organized studies done by Gallup, Booz, Allen & Hamilton, and A. T. Kearney on the market for the service.

38. PPM, 23.

39. Ibid., 24. But not all market assessments were this rosy. A 1992 study, executed between the 1991 and 1993 versions of the PPM, reported that a focus group study of "international travelers" revealed that though the proposed Iridium services held "value, they are not of great interest to these respondents." One reason cited was the increased ease of international calling, greatly facilitated by the emergence of communications through undersea fiber-optic cable in the late 1980s. It is hard to tell how the Motorola and Iridium principals weighed such negative assessments of the prospects of the venture. See "U.S. Iridium Qualitative Study for Motorola, Inc," March 1992, Iridium Papers, NASM.

40. PPM, 25–30.

41. Ibid., 35.

42. "Iridium PPM: Some Potential Investor Issues," p. 6, folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

43. "Agenda, 7 November, 1991," folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

44. William English, "Critical Issues: Closing, Investor Implementation and Operation," 11/12/91, folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

45. "Global Personal Communications Satellite, Service," folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

46. Ibid.

47. Ibid.

48. For a brief history of the limited liability corporation, see " LLCs: Is the Future Here? A History and Prognosis," *Law Trends and News*, American Bar Association, October 2004. https://www.americanbar.org/newsletter/publications/law_trends_news_practice_area_e_newsletter_home/llc.html. See also Robert Beury, Oral History Interview, Iridium Oral History Project, NASM, and Tuttle, Oral History Interview.

49. All quotes from memorandum "Earth Sensors for the Iridium System," November 5, 1991, folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

50. Ibid.

51. "Strategic Priorities," undated, folder "Iridium Strategic Planning Group," William English Oral History Working File, Iridium Oral History Project, NASM.

52. All quotes from ibid.

53. See Slotten, "The International Telecommunications Union."

54. As discussed by US policymakers, the underlying premise of US WARC planning activities discussed previously was explicitly to protect US geopolitical power.

55. United Nations, "Resolution adopted by the General Assembly, 1721 (XVI). International co-operation in the peaceful uses of outer space," 1085th plenary meeting, December 20, 1961, http/www:/oosa.unvienna.org/oosa/SpaceLaw/gares/html/gares_16_1721.html.

56. As a multinational corporation, Motorola had a range of issues relevant to WARC that extended beyond Iridium. But Iridium was its top objective.

57. US Congress, Office of Technology Assessment, *The 1992 World Administrative Radio Conference*, 71.

58. Ibid.

59. Post–World War II, while helping to prop up Europe economically, the United States at the same time sought to protect its advantages and deflect European advances in key technological areas: nuclear weapons, space, computers, and telecommunications. Such arrangements, though contentious, held into the 1980s. See, for example, Krige, *American Hegemony.*

60. US Congress, Office of Technology Assessment, *The 1992 World Administrative Radio Conference,* 72.

61. Rothblatt, Oral History Interview.

62. Ibid.

63. Quote from "Q&A for hipocket reference at press conference," Marie to Jerry, Leo, folder "FC 4 Storage," Box 2, Iridium Papers, NASM.

64. "Comments of Motorola Satellite Communications, Inc., Before the FCC," May 5, 1994, unfoldered, Box 3, Iridium Papers, NASM. Such rhetoric was in keeping with the times. Nearly contemporaneously, Vice President Al Gore made a speech to the International Telecommunications Union (ITU) in which he offered that "representative democracy relies on the assumption that the best way for a nation to make its political decisions is for each citizen—the human equivalent of the self-contained processor—to have the power to control his or her own life." Not coincidentally, a copy of this speech appeared in the same Iridium file as Motorola's FCC statement. Vice President Al Gore, "Remarks for Delivery, International Telecommunications Union, March 21, 1994," Box 3, Iridium Papers, NASM.

65. "Comments of Motorola Satellite Communications, Inc., Before the FCC," May 5, 1994, 11–12.

66. This account is drawn primarily from Rothblatt, Oral History Interview, and Roseman, Oral History Interview, but also from Durrell Hillis and Leo Mondale, Oral History Interviews, Iridium Oral History Project, NASM, as well as post-WARC industry accounts.

67. Roseman, Oral History Interview.

68. Lundestad, "'Empire by Invitation.'"

69. It was the nontrivial nature of these tasks that had led Iridium-Motorola to test Inmarsat's interest in serving as the commercial front for the business.

70. These points are made in a series of oral history interviews: Mondale, Oral History Interview; Kinzie, Oral History Interview; Beury, Oral History Interview; Tuttle, Oral History Interview; and others, Iridium Oral History Project, NASM.

71. This period is engagingly related in a number of interviews, but especially in Mark Gercenstein, Oral History Interview, Iridium Oral History Project, NASM.

72. On these points, see especially Gercenstein, Oral History Interview, and Tuttle, Oral History Interview.

73. Perhaps, surprisingly, the total cost of Iridium is not straightforward to determine. Though various contracts, such as that for satellite manufacture, deployment, and operation had a set amount, they didn't represent all the funds expended. The gateways, for

example, had expenses beyond those specified in contract, as did Motorola and the major suppliers. Though Motorola often referenced $5 billion as the total proximate cost, the figure likely was closer to $7 billion.

74. An outline of this process and Iridium's financial history is in the very last debt financing transaction the company executed—a bank facility with Chase Manhattan and Barclays de Zoete Wedd (BZW), the international investment arm of UK-based Barclay's Bank, finalized in December 1998. See binder "Bank Facility, Chase Manhattan and BZW," Box 6, Iridium Papers, NASM.

75. Mondale, Oral History Interview.

76. See presentation "Road Show," 1995, unfoldered, Box 6, Iridium Papers, NASM.

77. See especially Beury, Oral History Interview, and Tuttle, Oral History Interview.

CHAPTER FOUR: **"Freedom to Communicate"**

Note to Epigraphs: Top quote from "Freedom to Communicate," advertising brochure, Motorola, 1998, unfoldered, Iridium Papers, NASM; bottom quote from Robbins, *Feeling Global*, 4.

1. On the neoliberalism literature, see chapter 1.

2. The number of intersecting literatures of postcolonial studies and globalization is large. On globalization-oriented accounts, see the cites in chapter 1. On key works in which the postcolonial is foregrounded, see Appadurai, *Modernity at Large*; Cooper, *Colonialism in Question*; Tsing, *Friction*; Clifford, *Routes*; Ferguson, *The Media in Question*; Hannerz, *Transnational Connections*; Jameson and Miyoshi, *The Cultures of Globalization*; Kroes, *If You've Seen One, You've Seen the Mall*; Said, *Culture and Imperialism*; and Poster, *Information Please*.

3. These latter two points, for example, are central to Dipesh Chakrabarty's work and the discussion it has stimulated. See Chakrabarty, *Provincializing Europe*.

4. Bourdieu and Wacquant, "On the Cunning of Imperial Reason."

5. D. Bell, *The Cultural Contradictions of Capitalism*.

6. Fredric Jameson, Pierre Bourdieu, Jean Baudrillard, and Jean-François Lyotard are the main reference points for this analytic outlook. For Jameson, see variously Jameson, *Postmodernism*, *The Geopolitical Aesthetic*, *The Cultural Turn*, and *A Singular Modernity*. For a discussion of Jameson's importance to this discussion and his centrality to the related issue of postmodernity as a descriptor of the postwar condition, see Anderson, *The Origins of Postmodernity*. Bourdieu's signature work is *The Logic of Practice*. For Baudrillard, see Baudrillard, *Selected Writings*. The introduction by Mark Poster provides useful insight on the arc of Baudrillard's thinking. He began publishing on these issues in 1968 and continued until his death in 2007. Lyotard's writings have been equally seminal; see, as his best-known example, *The Postmodern Condition*.

7. In addition to cites already offered on neoliberalism's origins and development, see also Mirowski and Plehwe, *The Road from Mont Pèlerin*. For an example of the exploration of the zeitgeist of the 1980s and after, see Rodgers, *Age of Fracture*.

8. Yergin and Stanislaw, *The Commanding Heights*.

9. Turner, *From Counterculture to Cyberculture*.

10. In a journalistic vein this complex of changes is captured in M. Lewis, *The New New Thing*.

11. This optimistic, transformative ethos was a prominent thread in period thought; see, for example, M. Hauben and R. Hauben, *Netizens*.

12. As one example of such assessment, see M. Lewis, *Next*. For a nuanced historical analysis, see Streeter, *The Net Effect*, as well as idem, "'That Deep Romantic Chasm.'"

13. The most prominent forum for such views was the field of popular business literature, which boomed in the 1980s and after. A centrist view is presented in various period works by Peter Drucker; see, for example, *The Age of Discontinuity*. A more enthusiastic and neoliberal take is Gilder, *Microcosm*. Distinctly emblematic of this fusion was *WIRED* magazine, founded in 1993.

14. Fukuyama, "The End of History?"

15. Ibid., 8.

16. Memorandum, Roni Haggart to GRO staff, September 28, 1992, unfoldered, Box 6, Iridium Papers, NASM.

17. See chapter 3 for a sketch of Motorola's multiple points of participation across the US government.

18. Bradshear, "Science Fiction Nears Reality."

19. *The Wall Street Journal*, November 19, 1991, A3.

20. Ramirez, "The Ultimate Portable-Phone Plan."

21. Ibid.

22. An indicator of this phenomenon contemporaneous with Iridium is Holly Hubbard Preston and International Herald Tribune, "From Internet Chat Rooms, Some Surprisingly Reliable Advice," *The New York Times*, July 24, 1999.

23. For a useful overview of *WIRED*, see Streeter, "The Moment of Wired."

24. Joe Flowers, "Iridium," *WIRED* 1.05 (November 1993).

25. Ibid.

26. Ibid.

27. Emblematic of the literature critical of neoliberalism and globalization is Klein, *Fences and Windows*. A corporate-focused critique is Barnet and Cavanagh, *Global Dreams*.

28. P. Lewis, "Iridium Satellites Close to Girdling the Globe."

29. Tom Dowe, "The Gadget Gazettes," *WIRED*, August 24, 1998.

30. Pine and Gilmore, "Welcome to the Experience Economy." The historical roots of this phenomenon can be seen in Frank, *The Conquest of Cool*.

31. Dowe, "The Gadget Gazettes.

32. See *Roam* 4, no. 4 (1998): 6.

33. Ibid.

34. *Iridium Today* 2, no. 2 (1996): 4.

35. Ibid.

36. All the quotes are from "Talking points, Hong Kong," folder "Robert Kinzie Speeches, 1996–1997," Box 11, Iridium Papers, NASM. The folder also contains a sampling of other Kinzie conference participants. Underneath these ideological expressions was the question of multinational corporations and their operations in Asia. For a business-centric look at this point. see Palacios, *Multinational Corporations*.

37. *Iridium Today* 2, no. 3 (1996): 29. For a statement of the International Telecommunications Union's (ITU) commitment to neoliberal deregulation, see Fifth Regulatory Colloquium, "Fifth ITU Regulatory Colloquium."

38. Bennahum, "The United Nations of Iridium."

39. *Roam* 5, no. 1 (1998): 4.

40. Bennahum, "The United Nations of Iridium."

41. Anthropology as discipline has been one of the primary contributors to the literature on globalization, with particular emphasis on characterizing the interplay between capitalism and culture, both local and diasporic. For an important example, see Tsing, *The Mushroom at the End of the World*. For an anthropologically inflected account from a history of science and technology perspective, see Hecht, *Being Nuclear*.

42. Robert Textor, Oral History Interview, Iridium Oral History Project, NASM.

43. Ibid.

44. R. S. Moorthy, Oral History Interview, Iridium Oral History Project, NASM.

45. William Wiggenhorn, Oral History Interview, Iridium Oral History Project, NASM.

46. Ibid.

47. "The Iridium Revolution: Anticipating the Human Impacts and Sociocultural Implications of Global Personal Connectivity," Ray Leopold Oral History Working File, Iridium Oral History Project, NASM. In a cover letter conveying the manuscript to Motorola and Iridium leadership, Moorthy indicated that his and Textor's work was intended not only for their corporate audience but also for "specialists in telecommunications and sociocultural change (for example, the Office of Technology Assessment, U.S. Congress, has already requested copies, and we are committed to supply same as soon as possible). We believe that reaching this audience will significantly enhance the image of Motorola and Iridium, Inc., as socially responsible organizations."

48. Textor, Oral History Interview.

49. For background on the Delphi Method from Olaf Helmer, its originator, see Olaf Helmer, Oral History Interview, RAND History Project, NASM.

50. Textor, Oral History Interview.

51. "Iridium Revolution," 5.

52. Ibid., 6.

53. This notion received its fullest, initial expression in Cairncross, *The Death of Distance*.

54. Ibid., 32.

55. Ibid., 33.

56. Ibid., 39.

57. Textor, Oral History Interview.

58. "Iridium Revolution," 17.

59. W. Bell, *Foundations of Futures Studies*.

60. Textor, Oral History Interview.

61. "Iridium Revolution," 21–22.

62. Ibid., 84.

63. Ibid., 18–19.

64. Ibid., 44, 49–50.

65. Ibid., 50–54.

66. Ibid., 57.

67. Ibid.

68. Ibid., 58–59.
69. Ibid., 48.
70. Ibid., 81.
71. Ibid., 75–77.
72. Ibid., 82.
73. Ibid., 101.
74. This assumption of decentralizing has been a staple of post-1950s futurism, especially given the emphasis by Arthur C. Clarke in the early 1960s in the wake of the very first communications satellites.
75. "Iridium Revolution," 118–19.
76. Ibid., 121.
77. Ibid., 122.
78. Fukuyama, *The End of History*.
79. As noted in chapter 1, this optimistic-leaning view contrasted with Marshall McLuhan's 1960s concept of the "'global village," in which the new global condition was seemingly more anti-liberal than liberal.
80. For a broad historical view of the idea of corporate responsibility, see Carroll et al., *Corporate Responsibility.*
81. Galvin, *The Idea of Ideas*.
82. Moorthy and Galvin, *Uncompromising Integrity.* As a measure of the importance Motorola attached to this issue note that Robert Galvin was the son of Motorola founder Paul Galvin and chairman of the company at the time Iridium was initiated.
83. A particularly cogent analysis of culture in its post-1970 global dimensions is Baumann, *Culture as Praxis,* especially the introduction.
84. Cohen, *A Consumers' Republic.*
85. Wiggenhorn, Oral History Interview.
86. Ibid.
87. For an overview of this trend from a policy perspective, see Cunningham et al., *The Business of Borderless Education*.
88. This was Moorthy's own assessment of his work. See Moorthy, Oral History Interview.
89. Memorandum, Sue Marceau to War Games Marketing Team, March 9, 1996, "folder "War Games," Box 11, Iridium Papers, NASM. The data included in the memo came from Motorola studies of high-end cellular users.
90. C&R Research, "International Travelers Consider a Global Mobile Phone System from Iridium: A Report of Qualitative Research Findings," January 1997, p. 27, Box 9, Iridium Papers, NASM.
91. Saskia Sassen's and Manuel Castell's work emphasizes this point. See Sassen, *Deciphering the Global*, and Castells, *The Informational City*. On urbanization as a global process, see Brenner, *Implosions/Explosions*. For a first-person, narrative view of the affective and cultural meaning of global traveling and the airport experience, see Iyer, *The Global Soul*.
92. These quotes come from handwritten notes on remarks made by Mauro Sentinelli at an October 1997 gateway marketing committee meeting, Box 7, Iridium Papers, NASM.
93. John Windolph, Oral History Interview, Iridium Oral History Project, NASM.
94. APL Prospectus, Iridium Papers, NASM.

95. Ibid. For a look at the prominence of brands as element of 1990s life, see Betsky and the San Francisco Museum of Modern Art, *Icons*.

96. All quotes from "Ammirati Puris Lintas, Creative Brief," December 29, 1997, p. 1, Box 17, Iridium Papers, NASM.

97. Ibid. Such thinking was in line with that of Mauro Sentinelli, vice president of marketing and, prior to his time at Iridium, a critical figure in developing Italy's cellular telephone market. In early 1997, he stated his vision for Iridium as presenting "satellite access [as] the 'cherry' around which we will bake the BIG PIE of advanced conventional telecommunications services." "Iridium's Overall Marketing Strategy," p. 3, undated, Box 7, Iridium Papers, NASM. Though this document is undated, by context it is clear that it was prepared prior to June 1997.

98. All the quotes to follow come from Roger Bentley and Robert Quish, Oral History Interview, Iridium Oral History Project, NASM. Iridium corporate records, also at NASM, on the advertising campaign support the characterizations in the interviews.

99. "Ammirati Puris Lintas, Creative Brief."

100. C&R Research, "International Travelers Consider a Global Mobile Phone System from Iridium: A Report of Qualitative Research Findings," January 1997, p. 8, Box 9, Iridium Papers, NASM.

101. Sally Beatty, "Iridium Aims for Quick Connection with Ad Campaign for New Phone," *The Wall Street Journal*, European edition, June 23, 1998.

102. "Ammirati Puris Lintas, Creative Brief."

103. Beatty, "Iridium Aims for Quick Connection."

104. Memorandum, APL to Katherine Stormont, January 19, 1999, folder "APL Materials," Box 17, Iridium Papers, NASM.

CHAPTER FIVE: From "it's a bird, it's a phone" to "Edsels in the sky"

1. Ronald E. Yates, "Motorola's Satellite Telephone Network Nearing Liftoff," *Chicago Tribune*, January 31, 1995; Mark Leibovich, "Falling Back to Earth: Iridium's Steep Slide Reflects Dangers of Fast-changing High-tech Markets," *The Washington Post*, August 21, 1999, A01.

2. Joanna Glasner, "Iridium: Edsels in the Sky?" *WIRED*, May 10, 1999, http://www.wired.com/techbiz/media/news/1999/05/19522.

3. *Forbes* ASAP Staff, "Burning Questions, Final Answers," *Forbes*, May 28, 2001. In 2009, *Time* magazine offered the same assessment: "The 10 Biggest Tech Failures of the Last Decade—TIME," TIME.com, http://content.time.com/time/specials/packages/completelist/0,29569,1898610,00.html.

4. According to a series of oral interviews with Iridium staff, Staiano's intense, authoritative style as CEO had a broad impact on the organization. This seemed to affect two key aspects of the project. First, reflecting his background in developing Motorola's cellular equipment and infrastructure products was his relatively greater focus on the technical readiness of the Iridium system compared to a focus on distribution and sales. Second was his relationship with the gateways, which was perceived as top-down rather than collaborative.

5. "Marketing due diligence phase I report," Coopers & Lybrand Consulting, unfoldered, Box 4, Iridium Papers, NASM.

6. "Operational Update for Global Arrangers," March 8, 1999, unfoldered, Iridium Papers, NASM. On the development of international banking in the 1990s, highlighting the intersecting stories of the demise of the Soviet Bloc and the spread of neoliberal ideology, see Johnson, *Priests of Prosperity.*

7. As an example of the report's effect within Iridium, see Memorandum, Jerry Adams to Bruce Dale et al., October 25, 1996, unfoldered, Box 4, Iridium Papers, NASM.

8. Motorola Satellite Communications, Inc., "Iridium System Application," December 3, 1990, Folder "FCC Filing," Box 6, Iridium Papers, NASM.

9. For the original Iridium, the Department of Defense (DoD) also supported the venture through a substantial contract, but it was not the centerpiece of the company's business plan. For a detailed treatment of Iridium's bankruptcy and reconstitution as the new firm Iridium Satellite, see Bloom, *Eccentric Orbits.*

10. Cable, "Input-Maritime Update to ONDCP Transit Zone Assessment," January 26, 1999, Clinton Library.

11. Cable, "Egyptian Government Request for Proposal for a Radio Reconnaissance Station for Satellite Communications," September 23, 1999, Clinton Library.

12. The most optimistic studies saw about 42 million potential consumers—primarily "professional travelers"—as having a profile of consumption that would make Iridium a plausible service. See marketing studies, Box 4, Iridium Papers, NASM.

13. "The SIM Card / Calling Card International Focus Group Concept Test," January 1998, The Gallup Organization, Box 4, Iridium Papers, NASM.

14. See especially John Windolph, Oral History Interview, Iridium Oral History Project, NASM.

15. Quentin Hardy, "To Sell a Phone, Iridium Plays to Fears of Being out of Touch," *The Wall Street Journal*, June 4, 1998, http://www.xent.com/FoRK-archive/jun98/0048.html. Later in this article, though, Ammirati Puris Lintas (APL) found that the size of the phone might well be an asset after "on the street" displays of the phone elicited a positive reaction; its size was perceived as a status symbol, presumably because of the vaguely sexual characteristics of its tubular antenna.

16. "Iridium Satellite System Capacity," Draft Version 0.4, February 22, 1997, Box 11, Iridium Papers, NASM. This technical detail also was important to the banks as they assessed Iridium's credit-worthiness.

17. This point is emphasized in Leo Mondale, Oral History Interview, Iridium Oral History Project, NASM. Mondale served as vice president of marketing through the major negotiations with banks and oversaw their coordination with external marketing contractors.

18. "Iridium Banking Facility," December 8, 1998, Box 4, Iridium Papers, NASM. This document is several hundred pages in length, the bulk of which provides a summary history of the business, investors, and (the greater part) a catalog and discussion of risks, including the competition from terrestrial cellular and assumptions about likely consumers of the service.

19. See exchanges of correspondence, unfoldered, Box 2, Iridium Papers, NASM.

20. On these points, see Marc Gercenstein, Oral History Interview, and Robert Walz, Oral History Interview, Iridium Oral History Project, NASM. As CEO of the Iridium North American gateway, Walz was especially close to this set of problems, which will be discussed in more detail below.

21. Leslie Cauley, "Losses in Space—Iridium's Downfall: The Marketing Took a Back Seat to Science—Motorola and Partners Spent Billions on Satellite Links for a Phone Few Wanted," *The Wall Street Journal*, Eastern edition, August 18, 1999, A1.

22. Iridium press release, November 1, 1998, Box 3, Iridium Papers, NASM.

23. Production units of Kyocera phones did not become fully available until the spring of 1999.

24. Brazil, Gateway Report, unfoldered, Box 2, Iridium Papers, NASM.

25. The means of deferral was for Motorola to arrange a separate bank facility that covered the cost of the contract and have Iridium arrange payment later. See "Draft SEC Submission," March 1999, folder "Annual Report to SEC, 1999," Box 2, Iridium Papers, NASM.

26. See finance supporting materials, Board of Directors Meeting, January 21, 1999, Box 6, Iridium Papers, NASM.

27. Ibid. Iridium originally approved a contract for the INX (Iridium Next Generation) system in 1998, but deferred it until commercial activation had occurred. See "Report on Next Generation System," Board of Directors Meeting, January 21, 1999, Box 6, Iridium Papers, NASM.

28. Edward Staiano, "Weekly Memo," December 21, 1998, unfoldered, Box 2, Iridium Papers, NASM.

29. Transcript, Iridium conference call, January 25, 1999, Box 4, Iridium Papers, NASM.

30. Ibid.

31. Board of Directors, Minutes, January 19, 1999, Box 4, Iridium Papers, NASM.

32. "Financing Update," Board of Directors, Report, January 21, 1999, Box 6, Iridium Papers, NASM.

33. Folder "Notes (Sue K.)," Box 4, Iridium Papers, NASM.

34. Ibid.

35. Of course, at some level, these plans were PR documents, attempts to massage the future as a reality-in-waiting. But in the process of seeking to satisfy the banks through ever-greater detail, the plans did create a sense of confidence that the business projections genuinely correlated to an attainable future.

36. "Financing Update." The "Market Readiness Review" report from the same meeting noted that by mid-January there were only 5,520 "Iridium-homed" subscribers. Such a category described only subscribers who would use the satellite service. Another category of subscription was for those who used Iridium primarily as a means to have cellular service across different regional cellular communications protocols. Motorola and Iridium had anticipated this aspect of service as a critical feature for global travelers encumbered by moving across and through different standards in different regions of the world. By the late 1990s, the GSM (Groupe Spécial Mobile) protocol was emerging as a de facto international standard, lessening the importance of differing protocols as an impediment to international travelers and thus of the value of this category of Iridium's service offering. For this combined category satellite-based and cellular-based users, the bank covenants specified a total number of 52,000 subscribers.

37. The point regarding "one half" is in folder "Notes (Sue K.)."

38. "Market Readiness Review," Board of Directors, Report, January 21, 1999, Box 6, Iridium Papers, NASM.

39. The "Market Readiness Review" did offer "5 steps to a fast ramp up," with declaratives such as "Step 1: Close sales of reservations and transform leads into sales." But such statements presumed a level of readiness that did not exist at many of the gateways. In support of the latter point, see Walz, Oral History Interview, and Gercenstein, Oral History Interview. Staiano did, though, seek to tailor remedies to each gateway through an intensive review of site-specific problems, an effort that met with only modest success. He also sought to highlight the financial incentives in increased sales, not just in terms of revenue but especially in the higher stock values such success would engender. Stock analysts, he said, forecasted a stock price of $150 if the company became cash-flow positive in 1999, a potential windfall for the gateways and their investors. See Staiano, Board of Directors, Report, January 21, 1999, Box 6, Iridium Papers, NASM.

40. Recall that the gateways were separate business entities, with their own boards of directors. On the fraught relations the Iridium structure established between Iridium management and the gateways, see especially Walz, Oral History Interview. Walz served as CEO of Iridium North America, the gateway for the United States and Canada.

41. Staiano, Board of Directors, Report.

42. Gercenstein, Oral History Interview. But the issues seemingly were not only cultural. They also probably reflected the venture's revenue-sharing model. Again, Gercenstein: "65 percent [of revenue] went to Iridium on every dollar. The way Iridium got wealthy is by selling minutes of service and maximizing the revenue on the service. Well, the gateway only got about 30 percent of the revenue, so they had to really scramble and make money other ways. So what they wanted to do was to minimize the expenditures for as long as possible to conserve their cash, whereas Iridium kept saying, 'Listen, you've got to be ready on September 1, 1998, okay? Because we want to be ready to serve all territories around the world so we can get our maximum revenue.' The gateways were saying, 'Well, look. Why don't we just start out with one gateway and see how that goes, and then if that goes well, I'll put my money in.' Well, you know—natural, right? So these guys all start to play the game of, 'Well, it's my gateway. I'm going to run this thing.' They lost sight of the much bigger picture. The bigger picture was the global aspect of it. They were focused in their territory."

43. On this point, see "Business Plan Revision," ILLC Board of Directors Meeting, March 19, 1999, Box 2, Iridium Papers, NASM.

44. Memorandum, "Crash Sales Program," Bob Kinzie to Chris Galvin, Merle Gilmore, John Mitchell, January 22, 1999, Box 3, Iridium Papers, NASM.

45. Memorandum, "Standby Agreement between Motorola and ILLC," Larry Mishler to John Mitchell, January 18, 1999, Box 3, Iridium Papers, NASM. Another critical aspect of the contract was financing arrangements. Before the gateways could place orders for phones they also had to submit a letter of credit, which, in essence, required prepayment. One can fairly read this as Motorola not trusting the financial-worthiness of its fellow Iridium investors. As Kinzie noted, Motorola could provide the phones on an ordinary commercial basis, seeking payment in 30 days.

46. Binladin was brother to Osama bin Laden, a connection that did not go unnoticed, especially in the conservative press.

47. Letter, Hasan Binladin to Edward Staiano, February 15, 1999, Box 2, Iridium Papers, NASM.

48. Ibid.

49. These points are covered in "Exhibits prepared for required presentation to the Banking and Finance Committee, January 20, 1999," Jay Rava to Ravi Parthasarathy, January 8, 1999, unfoldered, Box 6, Iridium Papers, NASM.

50. C&R research, "International Travelers Consider a Global Mobile Phone System from Iridium: A Report of Qualitative Research Findings," January 1997, p. 30, Box 9, Iridium Papers, NASM.

51. The most detailed account of pricing I was able to find was in the DoD contract materials for Iridium service, from which these figures are taken. See "INA-H DoD Pricing," Box 6, Iridium Papers, NASM.

52. Booz-Allen & Hamilton, "Developing and Implementing a Distribution Strategy for Iridium Services in Brazil," February 14, 1997, folder "Marketing Brazil," Box 3, Iridium Papers, NASM.

53. "Usability Testing of Iridium's User Guide," Report, Market Research Team, 10/27/98, Box 2, Iridium Papers, NASM.

54. Memorandum, Iridium Korea to Bruce Dale, January 12, 1999, Box 2, Iridium Papers, NASM.

55. Ibid.

56. Email, Karli MacBan to Allen DuBose, February 17, 1999, Box 2, Iridium Papers, NASM.

57. Email, Sindy Yeh to Daniel Chun and Eric Song, March 19, 1999, Box 2, Iridium Papers, NASM.

58. Memorandum, Robert Kinzie to Durrell Hillis, et al., February 2, 1999, unfoldered, Box 6, Iridium Papers, NASM. This was offered without any commentary by Kinzie and derived from an action at the January board meeting to provide weekly updates on sales.

59. Letter, John Mitchell to Edward Staiano, March 5, 1999, Box 3, Iridium Papers, NASM.

60. Ibid.

61. Motorola Press Release, "Motorola wins contract to provide Iridium products and services to US DoD," 4/7/99, unfoldered, Box 6, Iridium Papers, NASM.

62. Email, Patrick Armstrong to Durrell Hillis, John Waldman, April 30, 1999, unfoldered, Box 6, Iridium Papers, NASM. Interestingly, the US Navy had done its own test of the Iridium system in December 1998 and was quite satisfied as to its ability to meet service needs. See "Beta Evaluation Report, Summary," SPAWAR System Center, San Diego, December 21, 1998, Box 2, Iridium Papers, NASM.

63. In his oral history Kinzie highlights the Y2K issue as a key impediment to establishing use of the system and a critical financial blow in the spring and summer of 1999.

64. David S. Bennahum, "The United Nations of Iridium," *WIRED* 6.10 (October 1998): 134–38, 194–201.

65. This was the perception by many in Iridium as well—a view grounded in the venture's history and Motorola's several decisions from 1995 through 1998 to serve as guarantor on a succession of bond and loan agreements. Marc Gercenstein, who initially worked for Motorola and was one of the principals in establishing the venture and then moved

to take a lead position at Iridium, never doubted through 1999 that Motorola would step in financially to give the project more time. But Motorola did not. See Gercenstein, Oral History Interview.

66. Email, Brad Sharrad to Jodi Heidbreder et al., March 23, 1999, unfoldered, Box 6, Iridium Papers, NASM.

67. These various points are covered in a series of internal memos from January to April 1999, unfoldered, Box 2, Iridium Papers, NASM.

68. Carleen Hawn, "High Wireless Act," *Forbes*, June 14, 1999, 60–62.

69. Ibid.

70. See various memos from the gateways on their troubles in lining up orders on a short time frame and with Iridium's difficulties widely reported in the media, unfoldered, Box 4, Iridium Papers, NASM.

71. These developments were widely covered in the media, in the United States and elsewhere. See, for example, David Barboza, "Bankruptcy Sought as Iridium Struggles," *The Moscow Times*, August 19, 1999, http://www.themoscowtimes.com/news/article/bankruptcy-sought-as-iridium-struggles/273441.html.

72. See, for example, Ray Leopold, Oral History Interview, and Kenneth Peterson, Oral History Interview, Iridium History Project, NASM.

73. Bloomberg News, "Craig McCaw to Buy Iridium, Analyst Says," *Los Angeles Times*, December 2, 1999, http://articles.latimes.com/1999/dec/02/business/fi-39654.

74. "Craig McCaw Plans Cash Infusion to Support Cash-Hungry Iridium," *The Wall Street Journal*, Eastern edition, February 7, 2000, 1, and "Iridium Set to Get $75 Million from Investors Led by McCaw," *The Wall Street Journal*, Eastern edition, February 10, 2000, 1.

75. Motorola press release, August 1999, unfoldered, Box 6, Iridium Papers, NASM.

76. Printouts of Cnet and Yahoo "chat" forums, unfoldered, Box 6, Iridium Papers, NASM.

77. Memorandum, Richard Everett to Tom Tuttle, May 17, 1999, unfoldered, Box 6, Iridium Papers, NASM.

78. One of the best outlines of these developments is Craig Mellow, "The Rise and Fall and Rise of Iridium," *Air & Space Magazine*, September 2004, http://www.airspacemag.com/space/the-rise-and-fall-and-rise-of-iridium-5615034/. More detail can be found in Bloom, *Eccentric Orbits*.

79. "DoD Awards $72 Million to Revamp Iridium," *Satellite Today* 3, no. 227 (December 7, 2000): 1.

80. Stephanie Paterik, "Iridium Alive and Well," *The Arizona Republic*, April 27, 2005. See also Reena Jana, "Companies Known for Inventive Tech Were Dubbed the Next Big Thing and Then Disappeared. Now They're Back and Growing," *Business Week*, Innovation, April 10, 2007.

81. Paterik, "Iridium Alive and Well."

82. PR Newswire Services, "Motorola Settles Iridium Bankruptcy Cases," May 20, 2008, http://www.prnewswire.com/news-releases/motorola-settles-iridium-bankruptcy-cases-57273692.html.

83. For an example of court action, see "Class action complaint for violation of fed-

eral securities laws," Parker Freeland on behalf of plaintiffs vs. Iridium World Communications LLC, Edward Staiano, and Roy Grant, US District Court, District of Columbia, Civil Action, 99–1002. In reading the depositions undertaken for the case, it is somewhat surprising to see that attorneys had difficulty in understanding Iridium as a business and the risk it confronted. See the depositions of Iridium personnel James Blaisdell, Richard Everett, and Craig Bond, Box 9, Iridium Papers, NASM.

Bibliography

Note on Sources

This study relied principally on two groups of primary materials. One is a body of Iridium LLC corporate records gathered at an opportune moment, at least for me as a historian. In the summer of 2000, as bankruptcy proceedings ground on with Iridium's ultimate disposition not yet settled, the company gave me access to its records, then in boxes strewn throughout its Reston, Virginia, offices. A selection of those records was a critical resource for this book. These are deposited in the National Air and Space Museum (NASM) Archive and are referenced in the notes as "Iridium Papers, NASM."

The second group is a collection of oral history interviews, conducted with Motorola and Iridium principals. A list of the interviewees is below. Not infrequently, interviewees provided primary records from their own files; these were placed in an interviewee "Oral History Working File," which designation is used in relevant citations.

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